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Modeling the head in clay of the Black Hawk Statue.

HOW A HUGE STATUE OF THE AMERICAN INDIAN WAS BUILT.—[See page 192.]

SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The New Dispensation or Development of Children by Environment

EUTHENICS, the sister science of eugenics, deals with race improvement through environment. It studies the hygiene of the present generation, while eugenics deals with race improvement through heredity for future generations.

Euthenics teaches us that diseases themselves are not inherited, but the power to resist disease is inherited, and unless this resistance is present a child is liable to fall a prey to the ever present microbes.

Heredity and environment taken together produce a child's characteristic health, and as heredity is nothing more than stored environment, every mother has a chance to add to that store, so that her child's health can be better than his parents.

The following principles are used to encourage the mother whose child has one parent with a bad heredity:

1. The inheritance from the healthy parent is stronger than the inheritance from the diseased parent.
2. A bad inheritance can be overcome by a good environment.

A mother, whose child has tuberculous inheritance, should take great precautions to prevent him from contracting the disease. First, unless she be tuberculous she should nurse him herself.

Cows milk is the source of fully one half of the cases of intestinal tuberculosis in children, and when this disease is contracted under one year, it is nearly always fatal. The greatest cause of infant mortality is due to the souring or growth of microbes in milk in hot weather.

Many physicians prescribe an artificial milk food for children which requires only the addition of water, to prevent infection. The best way, though, is to avoid milk, unless you are perfectly sure that the cows have been tested for tuberculosis, and unless the milk is germ free or has been pasteurized or sterilized.

A child's general diet at infancy, should be beef juice and orange juice in increasing amounts, from a few teaspoonfuls to several ounces from eight months on. From two and a half to three years he should have meat, which is finely scraped, well-mashed potatoes, and stewed fruits. The child should not have a diet composed largely of cereals or starches, for such a diet cannot supply the strength which a child needs for him to develop into a strong man or woman.

Next to the food, comes fresh air. The child should take all his naps out of doors, and at night a window should always be open, but without too much moving currents of air.

As the child grows up he should have out-door games, because such amusements bring appetite, health and sleep.

The next important thing is to prevent contagion. A nurse girl, who has tuberculosis, should never be put in charge of a child, and the child should never be kissed on the mouth, no matter by whom it may be.

All children should be taught to be clean—to prevent all diseases, but especially tuberculosis. The finger nails and hands should be kept especially clean. He should never use a drinking cup that another has used or even a glass that has been fingered.

The Half-mad

INSANITY has been variously defined in different eras and from many viewpoints—those of the scientist, the physician, the lawyer, the psychologist, the philosopher, the man on the street. And little wonder, considering the almost infinite complexity of human psychism. Besides, to define insanity with precision one must first answer the question "What is mind?" Who has ever done that successfully?

All gradations of the perturbed have been made, from the lovably daft to the hopelessly demented. And the point of view has, in the course of civilization constantly been changing. That of the present day is quite ultra-scientific, having been developed from the "rationalism" of Voltaire in the eighteenth century; it is a finding which will certainly be modified by future generations. For it considers many insane, or at least half-mad, who in other ages were rightly lauded as geniuses, saints, benefactors and world-compellers. It ignores the legendary, which is so fundamental in human nature, and so dear to humanity; it takes no account of the emotional, the poetic, the soul-stirring—entities, which after all make living the most worth while.

Prof. J. Grasset, of the University of Montpellier, has in his book "Demi-fous et Demi-responsables," designated as half-insane (Lombroso would have deemed them afflicted with "genius-insanity") such men as Pascal, Comte, Balzac, Hugo, Molière, Wagner, Schiller, Descartes, Cromwell, Goethe, Mozart, Byron, Tolstoi, Ampère, Dante, Columbus—even Shakespeare—and many another. Obviously, when one considers such men *demi-fous*, there is something wrong with the definition. Did St. Paul or St. Francis see visions? What would civilization be if they had not? Did Beethoven "rough-house" the homes of his princely friends who sought to relieve his needs? What matter to any one who has heard the Ninth Symphony? Was Caesar an epileptic? Was Napoleon a degenerate and a hypochondriac? Was poor Chopin's immortal music tinged with the toxemia of his consumption? Was Poe an alcoholic? Schopenhauer a misanthrope? Did Newton abstractedly stick his *flaccid* finger into his lighted pipe? (He died a bachelor.) Did Dr. Holmes' neighbors doubt his sanity when he put out (so it is chronicled) a sign "Small fevers thankfully received?" Darwin used to surprise his friends by starting all sorts of apparently crazy experiments. Of what matter all these things; of what use to call such men as these neurotics, or hysterics or *demi-fous*? Where would humankind be to-day had not they, and such as they, lived? Who would not, if he could, be in such company?

Grasset most wisely refuses, as is generally done, to divide humanity into two hard and fast groups, the sane and the insane; the group which is or should be placed in confinement, and that which confines it. Part of his work is given to the discussion of Semi-responsibility, Limited Responsibility and Attenuated Responsibility, to the end that such distinctions may find place in French jurisprudence. It seems they have already been accepted in many continental courts, though not at all in our own or in those of Great Britain.

Limitations of the Aeroplane

SURFACES are measured in square feet; volumes in cubic feet. An aeroplane is a surface horizontally driven through the air. The amount which it can support varies with the speed and with the area of that surface. An increase in the weight to be supported necessitates a considerable increase in the area of the supporting surface. Although the cubical contents of the weight may increase only slightly, the number of square feet in the supporting surface may increase considerably. For the present at least there is a limit to the size of supporting surfaces. As it is, the difficulty of properly securing and holding in place the wings of a modern monoplane is such that there is little, if any, room for that factor of safety which is considered so essential in the construction of bridges and tall buildings. There is good reason to believe that some of the most serious accidents which have occurred in the last year have been due to the collapse of improperly supported wings.

Great loads, as the history of transportation teaches us, can be economically carried only by great machines. That is the lesson taught by the modern 40,000-ton steamer and the 425-ton locomotive. Small crews, controlling machinery of enormous power, are able to guide gigantic loads safely to their destinations. At present the aeroplane is piloted as a rule by one man, and it carries one or two passengers only. For that reason, if the aeroplane of to-day were to be used for passenger transportation, an exorbitant fare would have to be charged. Only by increasing the size of the aeroplane vastly will it be possible to use it as a means of commercial transport; and that increase in size is impossible because of the difficulty of increas-

ing the size of the supporting surfaces, and of managing them by present methods.

Although it is impossible to build at present a single machine having a supporting surface sufficiently large for commercial purposes, it might be possible to combine a thousand small aeroplanes so as to form one immense supporting surface. The one thousand motors of these machines would be distributed evenly over the whole surface and the one thousand propellers, each connected with its own motor, would be placed above and below the combined surface. In this possible increase of size the designer would be confronted with the necessity of placing the one thousand rudders all along the rear edge, and the further necessity of placing these rudders not only along the rear edge, but at a considerable distance back, and of supporting them in suitable framework. Difficulties equally formidable would arise in properly disposing of and providing operating means for the wing tips.

It is not inconceivable that one hundred, and possibly more, passengers might be carried by a machine thus constructed. It is probable that the conglomerate machine would rise from the ground and fly for some time on a perfectly calm day. To start it, however, would be no easy matter. No doubt it would be necessary to mount the machine on a series of small wheels running on many parallel rails. Landing would not be out of the question in a perfect calm; but in a breeze it might be fraught with disaster. Even in slightly disturbed air such a combined machine would not be absolutely safe. So huge would be the supporting surface that the air pressure would not be evenly distributed. Stresses might be set up which might well break the machine in flight.

Imagine in place of this huge combined surface a flock of aeroplanes flying closely together in the same horizontal plane, assuming that the wash of the propellers would not interfere. A gust which happened to strike the aeroplanes of one side only would raise them above the horizontal plane in which they were all flying. If the flock of aeroplanes were rigidly connected, it is manifest that the connections would snap. It is apparent that an aeroplane's carrying capacity increases in proportion to its surface, and that the engineering safety of a flying machine decreases in exact proportion to the surface exposed to the wind.

None of these objections applies to the dirigible airship. There is no engineering difficulty in constructing a gas bag of any size. Indeed, the same advantages that can be claimed for the large steamship and the large locomotive can be claimed with equal force for the large dirigible. Even now, when the cost of constructing and operating a dirigible is alarming, the advantage is all with the gas bag when it comes to carrying loads cheaply. All the resources of modern engineering can be employed in the airship to obtain great strength with very little weight. As the linear dimensions of the airship increases, its surface decreases in proportion to the lift. The impossibility of increasing the vertical dimensions of an aeroplane without increasing weight that has no lifting effect, confines the engineer to an extremely shallow girder depth, which is the real reason of the aeroplane's frailty. On the other hand, the dirigible, with its great girder depth in every direction, for the same proportionate weight can be made remarkably strong. In a dirigible size counts in every direction; a linear increase up and down means just as much lift as a linear increase fore and aft, or right and left.

If it were possible to build an aeroplane of great size without materially increasing its weight and frailty, it would be possible simply to carry many passengers with a few trained pilots and to fly somewhat faster and for somewhat longer periods than is at present possible with a small machine. In a very large aeroplane the load can be cut down, to a certain extent, in favor of more powerful motors and more fuel. In the small machine this would be equivalent to amputating legs and arms. In stability, safety and navigability, aeroplanes gain by a comparatively moderate increase in size, which might render it possible to carry in comfort several pilots, engineers, and motors, and to install elaborate controlling devices and navigating instruments. The possibility of increasing the size, however, is soon brought to a definite limit, for the reasons given.

The Northeast Passage

BARON NORDENSKJÖLD'S classic feat of sailing completely around the northern coasts of Europe and Asia, accomplished in 1875-79, is likely to be repeated in the near future. As already stated in these columns, the Russian ice-breakers "Taimyr" and "Walgaitsch," now engaged in a surveying expedition along the coasts of Kamchatka and arctic Siberia, may possibly continue westward all the way to Archangel, via the Arctic Ocean. A much more elaborate expedition, however, is being organized in Germany by Lieut. Schröder-Stranz, who proposes not only to make the Northeast Passage, but to spend three or four years in the journey, carrying out extensive scientific researches en route.

Electricity

Making New Arc Lamp Carbons out of Remnants.—The thrifty German has developed a system of using arc lamp carbon stubs, that are ordinarily thrown away as worthless. The stubs of carbons that are taken from the lamps are squared off on a motor-driven grinding wheel and then they are cemented to a new carbon. This reconstructed carbon is placed in the lamp with the stub end at the arc so that the old carbon is eventually entirely consumed. The time occupied in reconstructing the carbons is inappreciable.

Electric Boats for the Great Lakes.—It has been announced that a 2,400-ton boat is being built for the Montreal Transportation Company, which will be equipped with a 300 horse-power Diesel engine coupled to an alternating current generator. This current will be transmitted to induction motors connected to the propeller shaft. The shaft will be driven at a speed of about eighty revolutions per minute. The induction motors will be directly controlled by the pilot by means of switches mounted on the bridge.

Fishing with a Trolley-wire.—The sale of large quantities of fish by dealers and peddlers in Lafayette, Ind., says the *Electrical World*, recently attracted the attention of the fish and game warden of Tippecanoe County, who, after investigation, assured himself that no seines or nets were in use in his district. Setting out to ascertain the source of the unusual supply of fish, he discovered two men near an interurban railway bridge, one of whom from time to time indulged in the extraordinary practice of striking his fishing pole against the trolley wire, after which the other would gather in a boatload of the dead and stunned fish which floated to the surface. Investigation showed that an insulated wire ran down the fish pole and dipped into the water under the bridge. The 500-volt contact with the trolley served to electrocute all fish near the wire, killing them outright, it is declared, instead of stunning them as in the case of dynamiting.

Trackless Trolleys for Shunting.—An interesting application of trackless trolleys is being made at Altona, Germany, for the shunting of freight cars. The fireless locomotives in use since 1909 will be replaced by trackless tractors operated by means of trolleys pressed by a rigid rod against a double pole overhead line. The trolley, arranged on the roof of the tractor, is designed for deviating on either side to a maximum distance of 3½ meters (11½ feet), so as to allow the tractor to travel on either track. A single overhead line thus suffices for the shunting service, and the loading of cars is not interfered with. The tractor, which is 6 tons in weight, has been designed for handling up to 6 cars with their full load at a speed of 3 kilometers to 6 kilometers (1.86 to 3.73 miles) and is worked by a 25 horse-power continuous current motor at 550 volts, driving all four wheels through a 10:1 worm gear. The coupling device is operated from the driver's stand, so that the brakeman need not pass between the buffers. The shunting line is 1.2 kilometers (¾ mile) long, and reaches as far as the boundary of Hamburg.

Telephones in the United States and Europe.—According to a bulletin issued by the New York Telephone and Telegraph Company, the United States leads the world in the total number of telephones by a wide margin. There are in the United States 67.4 per cent of all the telephones, and only 26.3 per cent in Europe. As against our seven and one half million telephones, the German Empire has but little over one million, while Great Britain comes next with nearly 649,000 and France third with 232,700. There are in New York city alone, more telephones than may be found in Belgium, Norway, Denmark, Hungary, Italy and the Netherlands combined. While Chicago alone has more telephones than France, and Boston has more than Austria. *L'Illustration*, of Paris, gives the following statistics, showing the number of telephones in seventeen of the principal cities in Europe in 1911, and the ratio of inhabitants to each:

	Number of Instruments.	Number of Persons to Each Instrument.
Stockholm.....	72,000	4.7
Copenhagen.....	45,000	11.4
Christiana.....	16,000	14.2
Stuttgart.....	16,000	15.5
Berlin.....	122,500	16.6
Berne.....	4,300	18.3
Munich.....	27,000	22.1
London.....	172,000	26.3
The Hague.....	8,000	36.1
Paris.....	75,400	36.7
Brussels.....	16,900	37.9
Budapest.....	18,000	39.4
Vienna.....	47,000	44.4
St. Petersburg.....	30,600	55.0
Rome.....	9,500	60.5
Lisbon.....	3,000	115.0
Madrid.....	3,500	155.0

New York has 402,000 telephones.

Science

Dust Laying.—The Highway Department of the city of Leeds, England, has recently treated portions of a macadam roadway with granular calcium chloride to combat the dust. Solutions of the latter had previously been tried at greater cost and without such satisfactory results. The road is first well swept and two applications of the chloride are made on succeeding evenings of about ½ pound per yard.

A Great Reservoir for Buenos Aires.—According to the *London Financial Times* the largest elevated reservoir in the world is about to be erected at Caballito, near Buenos Aires, in connection with the sanitary improvement schemes of the Argentine capital. It will consist of three tiers of wrought-iron tanks supported on cast-iron columns embedded in heavy concrete foundations. The total capacity will be 16,000,000 gallons, and the structure will be 123 feet high, from the base of the columns to the top of the roof. It will contain 15,409 tons of iron and steel. The contract has been awarded in England.

Acid-proof Iron Composition.—Iron alloys containing a certain percentage of chromium are usually employed in the manufacture of articles and apparatus which should resist the action of acids. These compositions are, however, not absolutely acid proof. Recently the well-known German metallurgist, Prof. Borchers of Aix-la-Chapelle, discovered that by adding molybdenum to an iron composition containing more than 10 per cent chromium, in amounts of 2-5 per cent, an absolutely acid-proof composition can be obtained. It is essential, however, that the iron be free from carbon, or at least nearly so. A composition containing 35 per cent iron, 60 per cent chromium and 5 per cent molybdenum, it is claimed, remains unaffected even by hot aqua regia. This alloy has the tenacity of cast iron and can be worked like the latter. Titanium and vanadium, may be used instead of molybdenum, but the latter is preferable.

Meteorological Stations in Antarctica.—With reference to a persistent rumor of great interest to meteorologists, Mr. H. A. Hunt, director of the meteorological service of Australia, says in a personal letter: "There was some talk before the Mawson Expedition went south about establishing a permanent meteorological station on the coast of Antarctica, but what the probabilities or even possibilities are will not be known until the expedition returns and reports upon conditions down there." A much bolder plan recently set forth by Admiral Peary in an American magazine contemplates the establishment and maintenance for a year of a scientific station at the South Pole itself. Meteorological observations would be the most important part of its programme. From several other quarters come hints of the fact that there is a decided drift of opinion toward the inauguration of a campaign of meteorological observations at fixed stations in south polar regions analogous to the one carried out in the arctic regions in 1881-83.

English Seaweed for Trimming Hats.—According to a recent number of the *Daily Consular and Trade Reports* a rather unusual industry along the Kentish coast has come to public attention through a complaint lodged with the Kent Fisheries Committee. The inhabitants of the Isle of Grain and the adjoining districts on the east coast of Kent, have for many years been collecting a white seaweed that is washed up along the shore, which seaweed has been used by London and provincial milliners as a trimming for women's hats. This, it seems, has grown into a profitable industry during the winter months, when farm work is not to be had. Its continuance is threatened by the practice of trawlers who attach barbed wires to their trawls and gather the white seaweed before it is ripe, selling the algae thus collected at a very low figure. In the ordinary way, the seaweed falls off from the roots and is washed ashore but the trawls pull it up by the roots and thus destroy the source of supply, besides leaving nothing for the islanders to collect but the refuse that has been thrown back into the sea by the trawlers. It was asked, among other things, that a closed season for the weed be adopted.

The Iron Mountain of Durango, Mexico.—The Cerro Mercado, as it is called after its discover, Vazquez del Mercado, is described in a recent consular report. Humboldt pronounced it the eighth wonder of the world. The mountain rises about 400 feet abruptly from the plain, is 1½ miles long, from a third to a half mile wide, and is practically a solid mass of iron ore, of 60 to 75 per cent iron. It is estimated that there is fully 500 million tons of iron ore above the surface of the surrounding plain, besides vast deposits beneath, probably extending well under the city of Durango. The most remarkable fact concerning these rich deposits, is that all attempts to work them profitably have been failures for several reasons, especially the long haul to market and the high cost of fuel. The new Durango-Llano Grande Railway, now approaching completion, will probably solve the problem, as it taps a timber country and the waste from timber cutting is expected to supply ample charcoal to use in smelting.

Aeronautics

Delivering a Flying Machine by Air.—A Caudron biplane was recently delivered by the maker to Commander Felix at St. Cyr. The distance from Crotoy to the point of delivery was ninety-six miles, which was covered in one hour and a half at an altitude of about four thousand feet.

The Talking Machine and the Aeroplane.—A novel use was made of the talking machine recently in a Farman biplane. A passenger dictated his observations, which were made on a record of specially strong material. This was then carefully wrapped and thrown to the ground, where the record was reproduced. How successful the experiment was, we are unable to learn.

Launcher for Aeroplanes.—In patent No. 1,033,148, to W. A. Bond of Lynn, Mass., assigned to Andrew M. Johnson of Lynn, there is shown a carriage adapted to support a flying machine. This carriage swings horizontally about a vertical axis and when the desired speed of the carriage is obtained, the aviator releases the flying machine so it can be thrown off from the swinging carriage.

A Splendid Record for Military Aviators.—Lieuts. Varcin and Battini, who are among the leading military pilots of the Maurice Farman aeroplanes, recently returned to the St. Cyr aerodrome after a six months' absence, during which they were engaged in scouting work of various kinds with the Mailly camp as a center. What is to be noticed is that they covered more than 12,000 miles and took about 600 passengers on these trips, these being officers who acted as scouts. All the flights took place without any accident and the aeroplanes are in good condition.

French Wireless Experiments.—The French officers are doing some very good work with aeroplanes carrying wireless apparatus and within a recent period the results are improving. The latest experiments were made by Lieut. M. de Varennes. Mounted on a Farman aeroplane he left the St. Cyr grounds near Versailles, carrying the telegraph operator Duriveau. He made a flight to Amiens, and was able to keep up wireless connection with the starting point when at a distance of 50 miles. No doubt a greater distance could have been covered but a violent storm prevented any further work on that day. Seeing that St. Cyr lies in a deep valley, the experiment was a more difficult one.

A French Military Postal Service.—A military aerial postal service is being started in the French army, and during the first trials the results showed all that could be expected. Lieut. Nieaud, mounted on a Farman biplane with Gnome motor, taking the officer Million as observer, made a flight at 6:45 A. M. from the Verdun camp, and after a trip at a very high altitude above the country in the east of France, he made a landing at the town of Nancy which is one of the leading military centers near the eastern frontier. The officers are charged with the postal service for the army and take letters which have a special aviation stamp upon them. There is no doubt that this service will be extended in the future.

Military Aviation in Russia.—The Russian army is actively taking up the aeroplane question at present. Not long ago two of the officers made a brilliant performance. Capt. Andrei is the first to make the flight between Sebastopol, Odessa, Moscow and St. Petersburg, covering no less than 1,800 miles on this occasion. Lieut. Dibowski also made a cross-country flight of nearly the same distance, both upon Nieuport monoplanes. The war department is taking measures to have aeroplanes fly in connection with the coming military maneuvers, and they are to be used alone, without employing airships on this occasion. At the Klementieff artillery firing grounds near Moscow, aeroplanes are soon to be used for observing and reporting the effect of the firing, and at the same point tests as to firing upon aerial objects will be carried on, using kites drawn by automobiles as a mark in the first place.

The English Military Competition.—In a review of the military competition held at Salisbury Plains last August, the editor of *Flight* comments: "Some of the entrants have lost many a brilliant opportunity of impressing the authorities with the capabilities of their machines. True, the weather conditions have been exceptionally bad, but we have seen the spectacle of a whole Flying Corps waiting and watching in vain for flights which, while not in the nature of observed tests, would nevertheless have impressed the army authorities with a sense of what may be called the weatherliness of the modern aeroplane. There is a difference between taking what are really legitimate risks and staying in the hangars with an obvious idea that prizes rather than orders for machines were the main object in view." This seems to have been the chief cause for criticism. *Flight* also points out that once more the need of an efficient, trustworthy engine was brought to view. Serious motor defects prevented at least two machines from accomplishing anything noteworthy. Others were far from economical in the consumption of lubricating oil.

A Novel Use of Cement in Sculpture

How the Statue to the American Indian Was Built

By John G. Prasuhn

MANY articles of literary merit have been written on Mr. Lorado Taft's concrete statue to the American Indian, but these have not made quite clear the technical side of the question—the methods employed in the construction. The writer, as builder, has been requested to set forth in simple technical terms the methods used in the building of this—so far as the writer is aware—the first heroic cement statue, which was dedicated near Oregon, Ill., on July 1st, 1911, and which has been open to the public view and criticism ever since the huge plaster mold was taken off in the early spring.

This statue, standing on Eagle's Nest Bluff, 250 feet above the Rock River, is 43 feet 4 inches in height. Five feet of the 14-foot 8-inch pedestal is exposed. From the end of the steel reinforcing rods, 2 feet in solid rock, to the top of the head it measures an even 60 feet. The statue contains about two tons of twisted steel reinforcing rods and approximately 238 cubic yards of concrete, twenty tons of which are one-fourth inch to dust pink granite screenings for the surface, giving it the appearance of a granite statue.

Approximately 65,000 gallons of water were pumped up from the river for maintaining two steam engines, and for mixing the cement. Four hundred and twelve barrels of Portland cement were used and the mixture was as follows: for the base 1 and 5; for the pedestal and steps going down into the statue, 1 and 4; for the figure, 1 and 3; and granite screenings, 1 to 1½, mixed with a water-proofing compound.

As is customary with most sculptors, the idea of a new work is expressed in the form of a sketch model. In this case the first model was only 8 inches high. The next size was 2 feet, and the third size 6 feet. This last served as the working model. Then a system was devised by which the enlargement was made, and when finished the enlargement was an exact duplicate of the 6-foot model, increased seven times.

In locating the site, a 24-foot silhouette was built, which was found to be too small from the point of view desired. Then a light 42-foot structure was erected on a farm-wagon, and the wagon was drawn around until the proper location was established.

The site having been chosen, a square central tower was built to the height of 38 feet and anchored with guy wires. Plans for enlarging the

model were drawn on the model by outlining all straight lines and flat surfaces, and numbering the points with a specially constructed machine, at the termination of

these straight lines and flat surfaces. A section of the surface of the model could be enlarged on the ground and drawn up by a rope, and nailed in place to correspond to the model. After all the points were made to correspond to the plan on the working model, wire netting was used for the curves; this in turn was covered with 200 yards of burlap for a surface, the burlap being pinned to the wire with nails at close intervals.

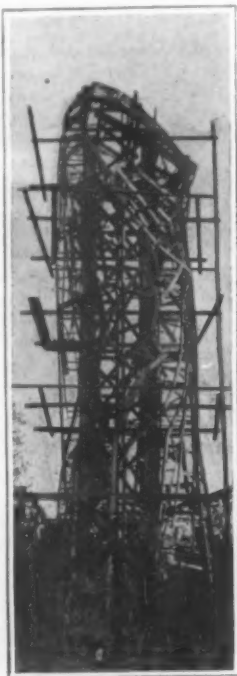
A specially constructed derrick was used for the hoisting and setting of the temporary head, which had been previously modeled. This served two important purposes—that of marking the precise location on the statue, and of facilitating the joining of the piece mold of the head to the mold of the figure. After the head had been placed the figure was turned 15 degrees to the right to present a clearer profile from the bluff road. The final modeling was now done and the surface was given a thin coat of plaster to stiffen the burlap, and then a coat of clay-water to insure its release from the mold later on. Both coatings were applied with a force pump.

The mold on the figure was now made of plaster and fiber supported by four 30-foot I-beams blocked up on cribbing timbers on a level with the top of the future pedestal. Every 4 or 6 square feet of the mold had independent bracing directly from the timbers on the I-beams, with strutting, cross bracing and hoops around the barrel-like structure, tending to equalize the outward strains imposed by the cement. The structure was built to shoulder level, the piece-mold fitted to the head and neck, and the two joined together in such a way as to be interlocking and self-supporting after the head had been removed and lowered in the same manner as it had been hoisted up.

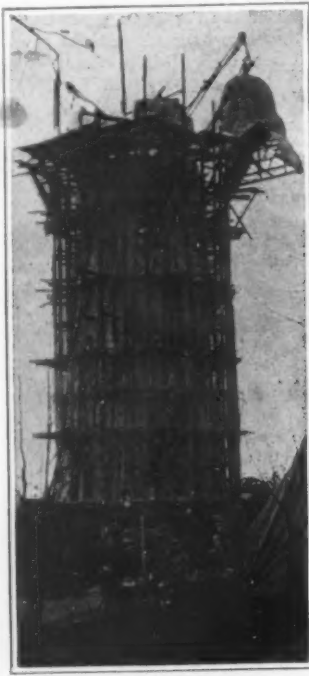
Excavating was carried on at the same time that the mold was being made. While this was being done the figure was shored up by timbers from the solid rock 11 feet below the ground level. The central tower was retained as a scaffolding until the piece-mold of the head had been fitted. The interior was patched and cleaned, and the interior of the mold was given two coats, one of wall size, and one of paraffine grease; the former to keep the plaster mold from absorbing the water from the cement, and the latter to insure its release.

The remaining scaffolding was then taken out

(Concluded on page 205.)



The wooden structure covered with wire netting.



The mold suspended over the excavation.



Hoisting the temporary head with a specially constructed derrick.



Concrete statue of an American Indian at Oregon, Ill.



Taking off the piece mold.



Chopping off the mold.

A Railway Car Driven by Gas and Electricity

A Substitute for Steam Trains Where the Traffic is Light

By the Berlin Correspondent of the Scientific American

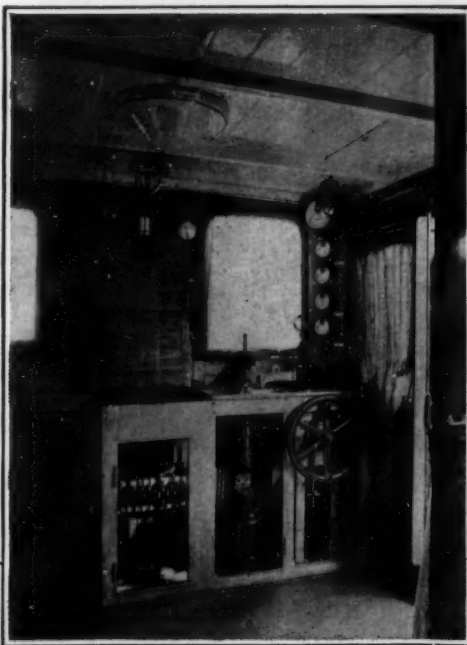
THE Prussian State Railways have for some time given special attention to the question of adopting motor railway cars on lines where there is little traffic. After carrying out preliminary trials with steam-driven motor coaches, twin storage battery cars were used on a large scale, while more recently gasoline-electric cars are being adopted.

The first car of this type was placed in commission in the year 1907. In view of the experience gained with this coach, the gas-electric set was rearranged under the supervision of Mr. Wittfeld, expert to the Ministry of Public Works. Successful trial journeys show that the new coach offers a very satisfactory solution of the question.

The car body is supported on two 2-axle bogie trucks which are provided with triple springs. In order to prevent the vibrations set up by the motor from being transmitted to the car and to insure a ready access to the generating set for the purpose of inspection, both the combustion motor and the shunt-wound dynamo employed for generating the electric current, together with its exciter, are mounted on one bogie truck.

The car body, which is 16,495 millimeters in length, accommodates a total of 95 passengers in a third and a fourth class compartment, and has in addition a driver's compartment at each end. Besides the appa-

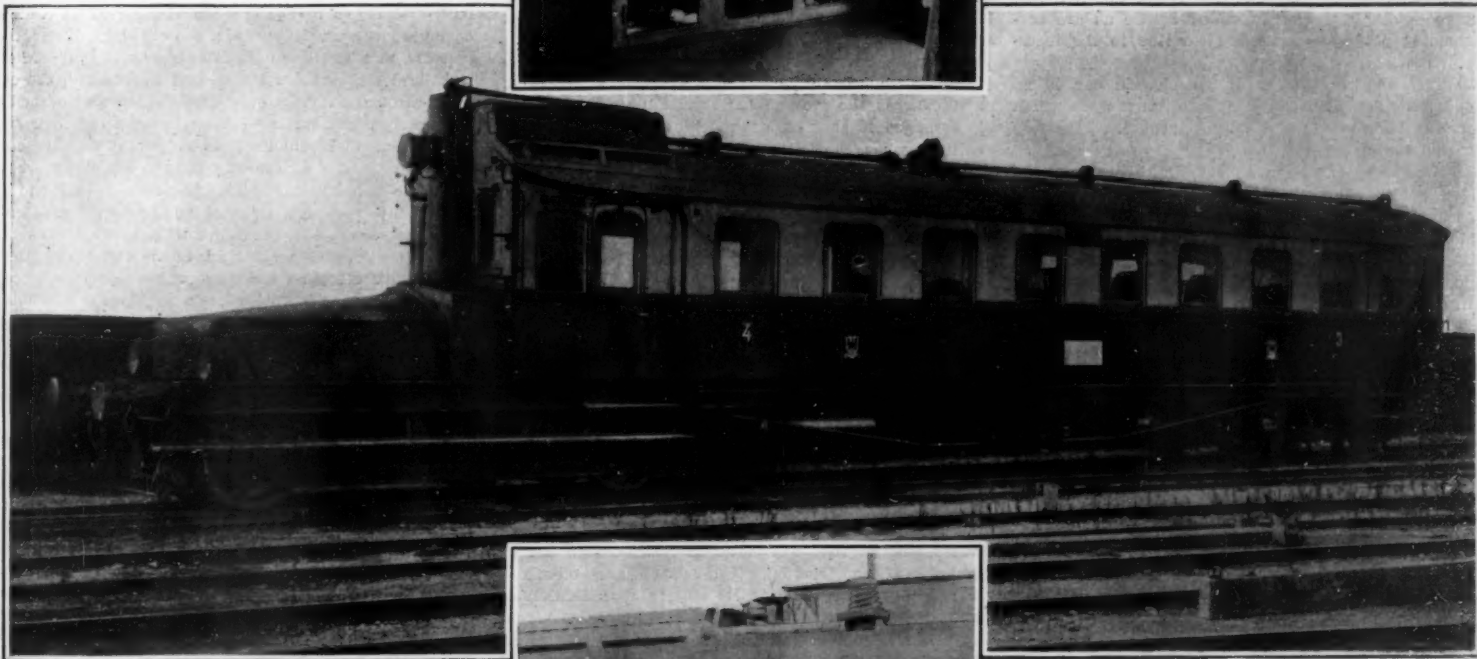
Apparatus in the driver's compartment.



four cylinders are fed from a spray carburetor which draws in hot air from a pre-heater built around the exhaust pipe. All the apparatus and auxiliary mechanisms mounted on the motor, such as the carburetor, ignition apparatus, cooling water pump, compressor, etc., are so constructed that they can be removed separately after loosening a few screws.

The combustion motor is coupled to the shunt-wound dynamo generating power, by means of a flexible leather link coupling. The dynamo has a continuous output of 66 kilowatts at 700 revolutions per minute, giving 220 amperes normal current at a pressure of 300 volts; it can give 580 amperes for a period of 30 seconds. Commutating poles are provided to insure sparkless running at all loads. The dynamo is suspended in the frame of the leading bogie truck, and is totally inclosed; it is cooled artificially by means of a Sirocco centrifugal fan. The exciter current is supplied by a compound-wound exciter having an output of 2.5 kilowatts at a pressure of 70 volts, which is mounted on the extended shaft of the dynamo.

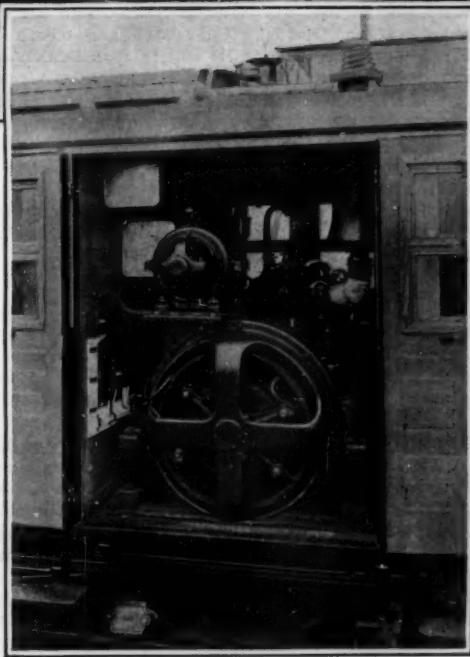
The car is driven by two railway motors, which in accordance with the regulations of the German Society of Engineers, each have an hourly rating of 82 horsepower at a pressure of 300 volts and a current of 230 amperes when running at a speed of 600 revolutions



A new gasoline electric railway car

ratus required for the control and braking of the car these compartments contain four and five folding seats, respectively, and serve for carrying heavy luggage which cannot be taken into the passengers' compartment.

A compressed-air brake of the Knorr type and a hand spindle brake are provided, both of which can be operated from either driver's compartment. The car is heated by water coming from the gasoline engine, which, before passing to the radiator mounted on the roof of the coach, flows through coils in the driver's and passengers' compartments. The gasoline engine, which was constructed by the Neue Automobile Gesellschaft, is of 4 cylinder type, and produces 120 horse-power when running at a speed of 700 revolutions per minute. The motor is under the control of a centrifugal governor, but is fitted with a device by means of which the speed at no load can be reduced to 250 revolutions per minute. This device is operated automatically from the controller. The cylinders are cast in pairs; the valves are all placed on one side and are actuated from a common shaft. The admission and outlet valves are of exactly the same dimensions and are interchangeable. The upper half of the crank-case comprises large openings at the side for inspecting the crank mechanism. The crank-shaft itself has four cranks set at angles of 90 degrees to one another, and is supported in bearings at three points. All crank-shaft bearings are placed on the upper half of the crank-case so that on removing the lower half, which is constructed of aluminum, the whole mechanism becomes accessible. A special point



The 120 horse-power generating set.

was made of obtaining lightness combined with great strength in order to keep the vibrations set up by the momentum of the masses as low as possible. A compressor fitted directly to the motor generates the compressed air required for braking the car and starting the motor. The current for the arc ignition is supplied by a Bosch high-tension magneto apparatus; an ordinary battery ignition is provided as a stand-by. All

under test on the Prussian State Railways.

per minute. With a gearing ratio of 1:4.315, the motors are capable of imparting a maximum speed to the coach, which has a total weight of 55 tons, including the passengers, of 65 kilometers (40 miles) per hour on the level.

The connections of the electrical equipment are carried out on the Ward-Leonard system, by altering the voltage of the generator; this arrangement meets all requirements of the service in a most perfect manner. The generator can, in fact, give at starting, when great tractive efforts are required, heavy currents at a low voltage, and the exact voltage can be obtained at the generator terminals in accordance with the speed of the motor. The combustion motor thus can always be run at a practically constant load and, therefore, at the most favorable speed and with the most economical fuel consumption.

The current for lighting the interior of the car and the signal lamps is supplied by the exciter and the battery connected in parallel with it when the generator set works at full speed. At a lower speed, and in particular when stopping at stations, the exciter is automatically switched off the lighting circuit, by means of a self-acting switch, when the battery alone feeds the lighting mains. The current necessary for the ignition of the combustion motor, for the signal bell and the motor siren is taken from the battery; the charging of the battery is effected by connecting it to the exciter.

This car was until recently placed at the disposal of the chief railway workshop, and has made a number of trial journeys on the Tempelhof-Zossen line.

Recent Improvements in Electric Vehicles

A Review of Important Patents Granted Within the Last Year

IT is remarkable to note the extraordinary favor with which the electrical vehicle is being accepted in the commercial world to-day. This is due to two facts, first, the natural and inherent advantages it has, because of extreme simplicity, and second, because it is being developed and manufactured by reliable and conscientious firms who have carefully developed it, and who invariably guarantee their products.

But popular as the electrical vehicle is at present it is bound to find far greater favor as its advantages become more appreciated. Furthermore, many small improvements and some important ones have been made recently that all tend to make it a more useful and serviceable piece of machinery. These are not radical changes in design or makeup; for the very first cars manufactured are quite similar to the most improved product to-day.

The first thing that strikes one is the ease of control, due to the fact that the electric motor requires no shiftable gears and no clutch mechanism. Starting is as simple and requires no more effort than turning on of an electric fan. By the use of a controller similar in principle to that used on the ordinary street car all the variations in speed up to full speed ahead or reverse can be obtained.

The use of the electric motor does away with noise, odor and jar that is a natural consequence of use of the gasoline engine. The absence of jerks and jars gives longer life of the machinery, saves greatly on tires, and the metal parts of the frame are not subject to crystallizing and becoming brittle as are corresponding parts of a gasoline car due to the incessant vibration.

In fact the mechanism of an electric car is so simple that there are really only two things upon which there can be any extensive improvement, i. e., the battery and the motor.

As for the recent improvements in the battery; no less a genius than Thomas A. Edison, the greatest American inventor, has done much for the electrical vehicle in bringing out the nickel-iron storage battery. Edison's problem was to make a compact battery which would be of less weight and of greater capacity than the previous lead battery. The old lead batteries were extremely heavy and had to be handled very carefully as they were quite fragile and subject to many diseases of all kinds which made handling of

an electrical vehicle somewhat problematical. Edison's battery is just half as heavy as a similar capacity battery of the old lead type. Hence, it is possible to carry more "battery" and to increase the mileage for a single charge. Only a few years ago the mileage radius of the pleasure vehicle was not over 25 miles, now with the Edison battery it is between 65 and 100 miles.

Another improvement (patent Pieper No. 1,026,827) makes it possible to charge the storage battery while the car is descending a grade. This allows "braking" of the car without actually applying the brakes, thus saving wear and at the same time storing up energy. The control switch of this motor is so arranged, in running down hill, that the batteries are automatically connected with the motor as soon as the voltage is great enough to charge the battery.

One drawback that has often been urged against electrical vehicles has been that it is not always convenient to obtain suitable charging current. In most cities lighting circuits are supplied with alternating current, which is unsuitable for charging batteries. One ingenious inventor (Bender No. 1,017,198) has solved this difficulty. He employs a motor made of two parts. One part is in reality an alternating current motor coupled directly on the same shaft as the other part, which is an ordinary direct current motor.

By means of levers the motor shaft is disconnected from the driving shaft, and at the same time a controller switch is so conditioned that the alternating current motor can be run from ordinary 110-volt lighting circuits, turning on the same shaft with itself the direct current motor, which now becomes a generator and charges the storage battery. An automatic trip is arranged to shut off the machine and disconnect it entirely when the battery is fully charged. This invention promises to increase the field of use of the electrical vehicle, for the alternating current motor can be arranged to run on any desired circuit, but still the batteries can be charged in the usual way if desired. In ordinary use the alternating current motor acts as a fly-wheel and adds but a very little weight.

There have been developed within the last year several clever schemes to cut off the charging current when the storage battery has been fully charged. One inventor takes note of the fact that as soon as the

batteries are fully charged they begin to give off gas. A rubber tube is connected with the vent of the cells and this leads to a pressure gage which opens the charging circuit when the gas pressure rises above a certain value.

Another inventor uses the increase in density of the liquid in the cells as a means for determining the extent to which the cells are charged and for cutting off charging current when the battery is fully charged.

Edison has invented an ingenious scheme to prevent the solution in the battery from passing off in gas during charging. The gas that is given off is caused by decomposition of the water. Now by putting a fine platinum wire inside the cell, and heating it while charging current is on, it is possible to cause the gases to recombine into water. Thus loss of liquid is prevented and refilling becomes necessary only at long intervals, if ever.

Another improvement of considerable note has been made in the transmission of power from the motor to the wheels. In most makes of cars in the past it has been the practice to use a chain drive. This is still most widely used on trucks and commercial vehicles, as the slight noise is of little consequence. But shaft drive is now being employed by several of the most prominent manufacturers, as it is silent and can be completely inclosed, giving a pleasing and highly finished appearance. To surpass this another ingenious inventor has patented a scheme whereby the motor is mounted concentrically with the rear axle and is entirely inclosed by the housing of the rear axle. The casing appears no larger than the ordinary differential housing on a gasoline car. The casing is made watertight and the inventor states that he can run the car right through a stream even with the wheels and motor completely under water without the least damage.

In commercial vehicles it is important to have considerable tractive or pulling power, especially where there are no pavements. This has been attended to by several inventors, one inventor has perfected a scheme whereby power is applied to all four wheels at the same time. This is arranged so as not to interfere at all with steering, and is a valuable improvement. Another inventor has added two more wheels, making six in all, and has arranged to have all of them driven, thus obtaining a great tractive effort at all times, regardless of the position of the car.

Oil-mixed Portland Cement Concrete

ORDINARY Portland cement concrete, because of its absorptive qualities, is used in some structures with only partial success. When made proof against the permeation of moisture, not only is its field of usefulness rendered more universal, but its efficiency is likewise greatly increased. A bulletin from the pen of Logan Waller Page, director of the Office of Public Roads of the United States Department of Agriculture, explains a very simple method for damp-proofing concrete by the incorporation of mineral oil residuum with the ordinary concrete mixture. It also describes the application of oil-mixed Portland cement concrete to several much-used types of structures in which a damp-proofed building material will be of benefit.

While experimenting in the Office of Public Roads in an attempt to develop a non-absorbent, resilient, and dustless road material, one capable of withstanding the severe shearing and ravelling action of automobile traffic, Mr. Page's investigations led him into a very promising discovery. He found that, when a heavy residual oil was mixed with Portland cement paste it entirely disappeared in the mixture, and, furthermore, did not separate from the other ingredients after the cement had become hard. The possibilities of oil cement mixtures for water-proofing purposes were recognized and extensive laboratory tests were immediately begun to determine the physical properties of concrete and mortar containing various quantities of oil mixtures.

Many valuable data have been obtained from these investigations. The damp-proofing properties of concrete mixtures containing oil have been demonstrated very definitely by laboratory and by service tests, which establish this material as one of great merit for certain types of concrete construction. It has also been shown that the admixture of oil is not detrimental to the tensile strength of mortar composed of one part of cement and three parts of sand, when the oil added does not exceed ten per cent of the weight of the cement used. The compressive strength of mortar and of concrete suffers slightly with the addition of oil, although when ten per cent of oil is added the decrease in strength is not serious. Concrete mixed with oil re-

quires a period of time about 50 per cent longer to set hard than does plain concrete, but the increase in strength is nearly as rapid in the oil-mixed material as in the plain concrete. Concrete and mortar containing oil admixtures are almost perfectly non-absorbent of water, and so they are excellent materials to use in damp-proof construction. Under pressure, oil-mixed mortar is very efficient in resisting the permeation of water. Laboratory tests show that oil-mixed concrete is just as tough and stiff as plain concrete, and furthermore its elastic behavior within working limits of stress is identical with that of plain concrete. The bond or grip of oil concrete to steel reinforcement is much decreased when plain bars are used. Deformed bars, however, and wire mesh or expanded metal will reinforce this material with practically the same efficiency as in ordinary concrete.

Detecting Icebergs and Land at Sea

IN a discourse delivered at the Royal Institution after the "Titanic" went down, Prof. Howard T. Barnes, of McGill University, described some recent experiments with the microthermometer in the detection of icebergs.

In studying the effect of ice on the temperature of the St. Lawrence River, he found that the ordinary thermometer was useless, and that only through the use of exceedingly delicate electrical instruments can temperature changes be observed. To test the influence of an iceberg on the water temperature he devised a practical form of electrical resistance thermometer, capable of recording thousandths of a degree of temperature, and called a microthermometer. The thermometer coil is composed of a large size iron wire, silk covered, wound between concentric cylinders of copper. The connecting wires pass from a cable to the observing room, where a recorder gives the temperature curve and variations on a chart. The relay galvanometer is of special design, to be independent of vibration, and is exceedingly strong and quite portable.

This instrument was successfully tested in Hudson's Bay in 1910. It was found that as the ship (a Canadian government hydrographic survey boat) drew near a berg, a rise of temperature took place first, followed

by a rapid fall. The effect was clearly shown on the microthermometer, but would have been missed entirely on an ordinary thermometer. Prof. Barnes calls this peculiar rise and fall of the temperature "the iceberg effect." It seems to be characteristic and easily distinguished from the small oscillations of temperature in the open sea. The rise is caused by the floating of fresh water from the berg, which water starts colder than the sea and gradually becomes warmer as the distance from the berg increases. At the fringe of this fresh water the temperature is actually higher than the sea temperature, owing to the absorption of the sun's heat. In the open sea, the warming of the sea by the sun is offset by the vertical circulation, but in the fresh and lighter water this is impossible.

During a trip from Halifax to Bristol, Prof. Barnes obtained a record of the sea temperature across the Atlantic. His instrument was placed in the circulating water drawn in by the pumps. The iceberg effect was obtained even in the water drawn from a depth of sixteen feet below the surface.

One of the most interesting results obtained with the microthermometer was the effect of land on the temperature of the sea. Whenever a vessel sails in toward the coast line the temperature is found to fall one or two degrees.

In passing over the great walls separating the shallower water about 400 miles west of the Irish Sea, Prof. Barnes found that the temperature rose sharply to a peak $1\frac{1}{2}$ degrees warmer than the surrounding sea, and immediately fell again, a phenomenon possibly due to the presence of a vertical current of warm water along this wall.

A solution of the iceberg problem seems near at hand, but the greater value of a means of locating land cannot be overlooked. An exceedingly sensitive self-recording instrument, such as Prof. Barnes' microthermometer, is essential. The conflicting experiences of North Atlantic sea captains alone testify to the uselessness of individual observations. Prof. Barnes points out that it is to a knowledge of the rate and characteristics of the temperature variation in the sea, rather than to the actual temperature itself, that we must look for means by which the safety of navigation may be increased.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

[Dr. Wiley Defends the Bureau of Chemistry]

To the Editor of the SCIENTIFIC AMERICAN:

I was surprised, and I must say indignant, at the tenor of your editorial of March 30th, 1912, in which you spoke in such a disparaging way of the young men and women who have been my assistants in the Bureau of Chemistry. As far as I am personally concerned, I never take umbrage at any kind of criticism any more than I become intoxicated with words of praise. No one realizes more keenly than I my own shortcomings and inefficiencies. I have one consolation, however, in this, that so far as I can recall, in all of the errors I may have made, I never have made one to the detriment of a consumer.

The aspersions on the ability and character of my assistants, however, I do not think should pass without a word of protest. Every person in the Bureau of Chemistry, with two minor exceptions, has received his appointment after a rigid examination by the Civil Service Commission. The total number of chemists employed in the Bureau of Chemistry at the time I resigned my position as chief was 189, of whom 106 were employed in Washington and 83 in the laboratories outside of Washington. Of this number 187 were graduates of colleges or universities. The 187 together hold 286 degrees. There are 131 B.S., 41 M.S., 39 B.A., 16 M.A., 26 Ph.D., 12 M.D., and 21 holding other degrees, making altogether 286 degrees held by 187 graduates.

These degrees are from colleges and universities in all parts of this country and in Europe. There are two from Boston University, two from Brooklyn Polytechnic Institute, five from the University of California, four from Clark University, three from the Cincinnati University, nine from Columbia, fourteen from Cornell, twenty-nine from George Washington, eight from Harvard, fifteen from the University of Illinois, two from Johns Hopkins, three from the University of Kansas, four from the Kentucky State University, seven from the Maryland Agricultural College, two from Massachusetts Agricultural College, thirteen from the Massachusetts Institute of Technology, twelve from the University of Michigan, three from the Agricultural College of Michigan, two from the University of Minnesota, thirteen from the University of Ohio, three from the Agricultural College of Oklahoma, two from Pennsylvania State College, ten from the University of Pennsylvania, six from Purdue University, four from Princeton, two from Stanford, three from Tufts, nine from the Virginia Polytechnic, two from the University of Virginia, six from Wisconsin, ten from the Worcester Polytechnic, eleven from Yale, one from the University of Halle, one from the University of Erlangen, two from the University of Göttingen, and three from the University of Heidelberg.

In addition to these, the Inspectors of the Bureau, who are not expected to be college men, are largely the holders of college degrees. Of the forty inspectors, twenty-seven are graduates of colleges.

In order that you may have an accurate idea of the nature of the examinations passed by the chemists entering the Bureau, I addressed a letter of inquiry to Commissioner Black of the Civil Service Commission, and inclose a copy thereof and of his reply. It shows the fundamental training received by the men of the Bureau of Chemistry, and the conditions under which they entered the Bureau.

In regard to the training in the Bureau itself and the work done, I would say that to a large extent, the field of food and drug chemistry being comparatively new and so extensive, we developed, in a way, a training school for food chemists, and our chief difficulty in maintaining the efficiency of the Bureau was that the work of the men was so valuable and so widely known, that they were continually taken away from us by commercial firms, who paid larger salaries than we could in the Government. This can hardly be considered an argument against the efficiency and training of the men engaged in the work, inasmuch as no one will contend that commercial interests are in the habit of employing, at high salaries, men who are not expert in their specific lines.

I doubt if you can find a more capable, more devoted, and more loyal body of college graduates, of the same number, anywhere in the United States. I feel certain that you must have made the statements you did under a misapprehension of the facts, and I sincerely hope that you will take occasion to correct the impression which your editorial has undoubtedly made.

Washington, D. C.

H. W. WILEY.

[Dr. Wiley mistakes an academic degree for scientific efficiency. Whether or not the employees of the Bureau of Chemistry passed Civil Service examinations or graduated from institutions of learning is beside the point. We are concerned only with the effective administration of the Pure Food and Drugs Act, in securing

the passage of which Dr. Wiley performed a conspicuous public service.

Dr. Wiley states that so far as he can recall he never made a decision to the detriment of a consumer. We would refresh his memory by citing a decision of his which was published fully in the *Washington Post*, and which permitted the use of lead in baking powder. Lead is a poison cumulative in its effect. Surely this was not in the interest of the consumer.

The mere existence of the Referee Board, appointed by President Roosevelt and composed of men of the highest scientific standing, speaks for itself. That board was created for the sole purpose of checking up the work of the Bureau of Chemistry. It has cost this country hundreds of thousands of dollars. To be sure, the idea has been spread abroad that the Referee Board is the tool of food and drug adulterators; that its existence is a menace to the public. On questions of scientific fact, such men as its chairman, Dr. Ira Remsen, are not easily fooled. Nor may one accuse them of corruption without impunity and without incurring a justified indignant protest from every scientific man. So long as the Referee Board is required to continue its critical examination of the Bureau of Chemistry's doings, so long must the Bureau of Chemistry be regarded as scientifically unfit for the task of prosecuting food adulterators.

As an example of the inefficiency of the Bureau of Chemistry we have only to cite the benzoate of soda studies. The important question of the effect of sodium benzoate was intrusted to a medical student who had not even a degree of M. D. Totally inexperienced, totally unfit for this important task, is it any wonder that his results were repudiated by such experienced and respected scientists as Lehmann, the distinguished hygienic authority of Würzburg University? Is it any wonder that President Roosevelt found it necessary to appoint a board which would conduct investigations with scientific accuracy to determine the effect of benzoate of soda? And is it any wonder that the findings of an incompetent medical student should have been reversed?

The Pure Food and Drugs Act is one of the most important pieces of legislation ever passed in this country. That it should be administered by men whose scientific incompetence is a matter of common knowledge is unfortunate for the consumers whom Dr. Wiley states he has always sought to protect.—EDITOR.]

The Scientific Feet of the Bureau of Chemistry

To the Editor of the SCIENTIFIC AMERICAN:

I was interested in reading in your August 3d issue an editorial with the caption "Wanted—A Chief for the Bureau of Chemistry."

The article reads, in part: "Months have now elapsed since Dr. Wiley resigned as chief of the Bureau of Chemistry. That no successor has as yet been appointed may be attributed to the fact that it is no easy task to induce a scientist of commanding position and personality to accept an annual salary far less than the sum which he could earn in a year in private practice. Moreover, the conditions under which work is now carried on in the Bureau of Chemistry would be intolerable to any really scientific man."

Your statement that it is no easy task, etc., is absolutely correct, and it is on this account that the Referee Board was established—a Board composed of scientific experts whose qualifications were such that any investigations conducted by the Board would be recognized in the scientific world as well and faithfully done.

In reference to the conditions existing in the Bureau of Chemistry, I beg to say that there is less friction there now than there has been for some time, as the work is being done harmoniously.

You say, "Selfish manufacturers are bound to do all in their power to make his official life as unbearable as possible, and the spirits that now dominate the work done by the Bureau of Chemistry in passing upon the legality or illegality of the doings of the food and drug manufacturers would hardly be in sympathy with a real scientific chief."

In reference to the above assertion I beg to say that it is the manufacturers who are desirous of having experiments conducted by a truly scientific board.

You also say in part: "As matters now stand, the Bureau of Chemistry has the lamentable distinction of being the only department of the Government that cannot stand on its own scientific feet, and that requires scientific supervision by another body."

In reference to the above, I beg to say that the Bureau of Chemistry never had any "scientific feet to stand on."

You also say, "At present wealthy dishonest food manufacturers find it no difficult task to escape the punishment they so richly deserve. Opposed by well meaning but incompetent employees of the Bureau of Chemistry, they find it no difficult matter in court to offset their unscientific evidence by expert testimony, which can be bought at a market price, and which is

at least as good as the evidence offered by the Government."

In reference to the above statement, I beg to say that the judgments secured against various so-called "wealthy dishonest food manufacturers," up to August 3d, 1912, numbered 1,550.

Dr. Wiley, in his report on the Committee of Expenditures in the Department of Agriculture, 1910, when he was asked by the chairman, "Do you find difficulty in keeping bright young men in the department at the present time?" said: "That is the great difficulty. As soon as a young man becomes noted for his work he is in great demand, not only in other bureaus and other branches of the public service, but he is in great demand for college and technical work outside. I think the Bureau of Chemistry has lost a larger percentage of its good men than almost any other Bureau in the department. We are losing them constantly."

It was disclosed, during the Coca-cola case, that Dr. Wiley refused to testify, saying he "could not qualify as a chemist, a pharmacologist, a toxicologist, a physiologist, a physiological chemist, or a doctor of medicine either to his own satisfaction or to the satisfaction of the Government."

The above clearly demonstrates that the so-called chief of the Bureau of Chemistry could not qualify as a chemist, and that he was unable to retain good men in his employ, consequently, when truly scientific questions arose they were referred to a board composed of the best scientists obtainable in the United States.

The above are facts, and as the SCIENTIFIC AMERICAN is desirous of giving its readers scientific facts, I trust you will give them an opportunity to peruse the above.

New York, N. Y.

H. L. HARRIS.

The Electric Niagara

To the Editor of the SCIENTIFIC AMERICAN:

The issue of June 29th discusses the "Electric Niagara" in France. It occurred to me when reading this article that the French may explain their procedure in such experiments as those performed by Sir J. J. Thomson and others on the effect of potential on cloud formation. Vapor seems to have a tendency to coagulate if there are small particles present which form a nucleus. Such nuclei result in diminution of vapor tension and consequent cloud formation. Electric charges seem to form nuclei or accelerate cloud formation, but to my recollection the condition is a critical one.

Rain drops and hail stones require nuclei; and perhaps the French preventive methods, while they are not large enough to handle all the electricity that nature stores, may be supposed to make enough trouble to prevent the critical condition and thus prevent the formation of the starting nuclei.

Cleveland, O.

J. C. BOERTLEIN.

[It is quite true that free electrons, however produced, serve, under certain conditions, as nuclei about which water vapor may condense into droplets, but the conditions are so unusual that it seems impossible for them to take place in the open atmosphere. Even the negative electron, which is a much more effective nucleus for condensation of water vapor than is the positive electron, requires (a) that the air be free from all dust, and (b) that the water vapor present shall produce at least a four-fold supersaturation. But as dust, according to innumerable observations, is always present in the atmosphere, it follows that supersaturation is impossible in the open, and therefore that no amount of ionization can materially affect either the time or amount of rainfall, hail, snow or any other form of precipitation.

From experiments and observations begun by Simpson in India, and continued by others in various countries, it is practically certain that the electricity of thunder storms, whether accompanied by hail or otherwise, is only a by-product of the storm itself and in no sense its cause. Hence to modify it either in kind or amount would be to modify only one of the things which the storm produces and not that which produces the storm.—EDITOR.]

When the Poles Attract Each Other

To the Editor of the SCIENTIFIC AMERICAN:

C. C. Kiplinger, in the issue of March 16th, cites experiments to prove "like poles attract each other." Unfortunately, it seems as though such things as "magnetic rounds" and other luxuries have ousted the old "filings" experiments from the board. Had he tested with filings he would have found the true cause, which is a very old phenomenon, that of local "reversal of polarity," the larger magnet causing a temporary reversal in the end of the smaller, which then acts as a piece of plain iron or steel. If a steel magnet be used, and then tested, after separation, by filings, it will be found that "consequent poles" have been produced. With the electro-magnet these disappear immediately on separation. I would like to know what he means by "similarity of magnetic and pressure phenomena."

HAL McKAIL.

Kalgan River, West Australia.

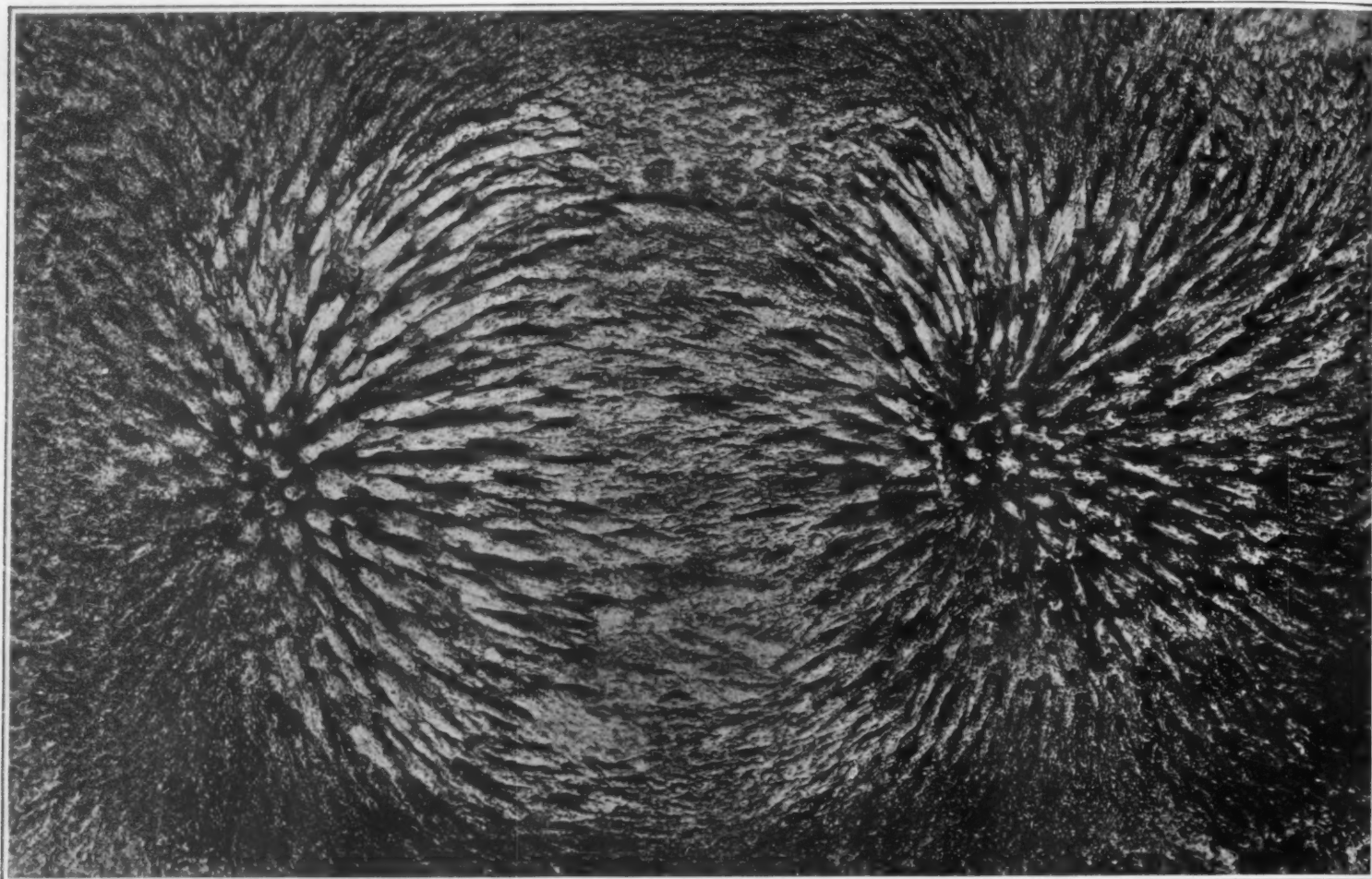


Fig. 1.—Plan view of the field of force between the two poles of a magnet.

Making Models of the Magnetic Field

Fixing the Iron Filings With Plaster of Paris

By Nathan C. Johnson

THE mapping of the magnetic field of force by means of iron filings sprinkled over a glass plate, beneath which is a magnet, is a very old experiment. Faraday was perhaps the first to perform it; and his sketch of the field of force between two parallel conductors as revealed in this way is the earliest record we have of this phenomenon.

Since then, however, the experiment has been performed times without number; but its usefulness has been limited by reason of the decoherence of the filings with the loss of their form as soon as the exciting force was removed, or any unusual conditions of mechanical shock were introduced. Further, only a two-dimension map of the field of force was produced; and although it was known very soon that under normal conditions the field was of equal intensity on all sides of a central line through the poles, yet we have heretofore lacked more than transient ocular proof of this fact.

With a view to overcoming these difficulties and of determining both the form and the intensity of the field under varying conditions of polar form in such manner that the results could be studied at leisure, the experiment herein described was devised. Briefly, it consists in using a mixture of iron filings and plaster of Paris made into a paste with water and sifting this paste over the field area through a medium-mesh sieve. As the iron is carried in suspension in the paste, the mixture is attracted by the poles and the intervening stressed space in proportion to the magnetic intensity; with the result that when the mixture has hardened, due to the setting of the plaster, a relief

map, or a three-dimension model of the field of force, is obtained. Photographs of models made in this manner are shown herewith.

Fig. 1 shows a three-dimension map of the field of force between the poles of a powerful electro-magnet. The magnet had square poles, but the effect of this form is not noticeable, due to the intensity of the field employed. In making this map, the procedure outlined above was followed, a glass plate being placed over the poles of the magnet and the paste of plaster and iron being sifted over the plate through a sieve. As before explained, the paste is attracted away from the natural line of fall into the lines of passage of the magnetic flux; and the more intense the field in any locality, the greater the quantity of material at that portion in the resultant map. Therefore, the elevations of the different portions show approximately the intensity of the force at that point; and the direction and inclination of the spines or points rising from the surface also indicate the form and direction of the air lines which were not intense enough beyond a short distance from the pole to hold the material in suspension. In Fig. 2 is shown a profile view of this map, which makes the relief feature more distinct.

Of course the work of applying the paste has to be done very quickly; and the paste must be of just the right composition and consistency to secure good results. Repeated failures are almost sure to be the price of the first success; but once the knack is learned, the procedure will be found easy and the results very instructive. It should also be added that an additional

value is given these models by the distinctness and beauty of their color, due to the rusting of the iron, which brings out the lines of force in excellent contrast to the white plaster; and in the map under consideration, a further value is conferred by the reverse side, that which was next the glass plate, having an unusually distinct and accurate force map in two dimensions showing on its surface. This was not photographed because the figure is so well known as not to warrant reproduction.

Fig. 3 shows the field of force of a short solenoid without a core. The making of this model was a very difficult piece of work, due both to the difficulty of obtaining a field intense enough to form the paste properly without undue heating of the coil, and to the necessity of sawing the coil in half afterward without injury to the finer spines of the model. It is to be regretted that some of these have been lost, but enough remain to show the field well. The author hopes in the near future to carry out this work further and to investigate by this same means the leakage in solenoids and the field of force when using different forms of plungers.

By various methods we have long ago determined the effect of various shapes of pole pieces on the attractive power of magnets. Perhaps the first important researches in this regard were made by Dr. Julius Dub in 1850, an account of which is given in his book "Elektromagnetismus." His method of procedure was to have pole pieces of various forms and dimensions which could be screwed upon the core of an electro-

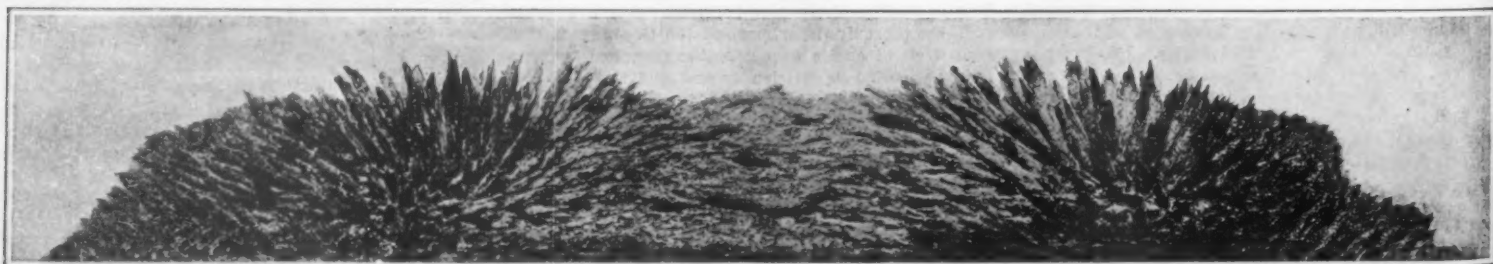


Fig. 2.—Profile of the field of force between the two poles of a magnet.

magnet. Then, with a given excitation of the magnet, he determined the attractive power of the different pole faces by noting the deflection of a magnetized needle hung some distance away by a bifilar suspension. Sturgeon and Count du Moncel also investigated these phenomena, adding to the investigations and conclusions of Dub a research on the leakage of flux with the different pole pieces. At about the same time, Von Kolke investigated flux distribution over different polar forms, and by using a small steel ball, suspended from a spring balance, he measured the pull on the ball over different portions of the polar area. The results of these pioneers have since been substantially confirmed by later investigators, using more refined methods; but it may be interesting for us to prove these results visually by means of the plaster and the iron models.

Fig. 4 shows the field of force over a large flat pole piece. The directions of the lines of force are very well shown in this model, as well as the intensity of the force, showing the great energy at the edges and the relatively small intensity at the center of the pole. This is as we would expect, for from the edges, the lines have a shorter path back to the opposite pole than they have from the center, so that there is greater magnetic density at the edges. A curious optical illusion may also be observed in connection with this photograph. If it is turned upside-down, the perspective of the photograph appears far different from that of the proper position.

Fig. 5 shows the effect of a small flat pole having an air return. By this latter is meant that the opposite pole of the magnet is a considerable distance away, and that the magnetic circuit is completed through the air, with no nearby iron return circuit to build up the intensity of the field. We see from this model that with such a pole, there is a considerable concentration of the force lines at the edge, with resultant spreading. Compared with the intensity of the center of the pole, as evidenced by the length of the spines, the intensity at the sides is much greater.

Fig. 6 shows an exaggerated case of the same kind. In this, the pole face is twice the diameter of that in the preceding, and we have a corresponding increase in concentration at the edges as evidenced by the radiation, and a very noticeable diminution of intensity at the center. It should be understood that in making

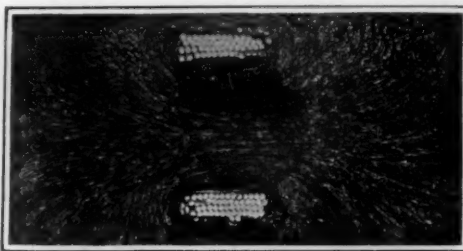


Fig. 3.—Field of force of short solenoid without core.

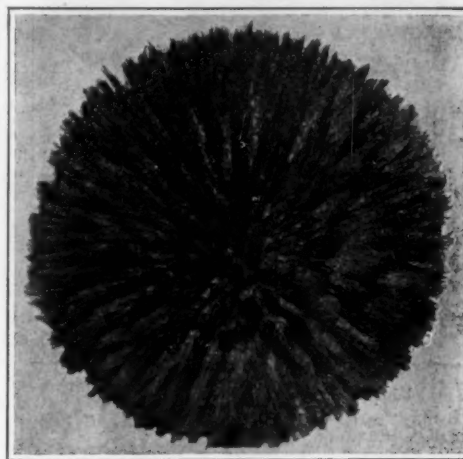


Fig. 4.—Formation over large, flat pole piece.

itself. After hardening somewhat, it was split open to show the interior structure, which should give us the force distribution over the polar face, as well as the field intensity and form. That this result has been accomplished is evident from inspection. It is at once seen that the conical pole has the greater concentration of the two, with extreme density of flux from the point; while the rounded pole shows less concen-

centration of the conical pole. The bending over of the lines of force emanating from the flat pole can be very clearly seen in this figure.

Fig. 11 shows the enlarged flat pole as contrasted with the conical pole. This model became too hard to split down the middle, but the interior is hollow for a third of the length from the flat pole, except at the edges, where the material is very dense and converges sharply toward the center. As the quantity of iron in this model is considerable, the lack of radiating spines from the edge of the flat pole may be accounted for by the formation of a magnetic short circuit through the model.

That there are certain defects inherent in these models, and in this method of mapping the magnetic flux, the author recognizes; but they are submitted in the hope that by their use some information may be gained that may eventually lead to a better understanding of some at present puzzling phenomena.

Insects and Formol

IT is a matter of some surprise that insects can live in such a powerful antiseptic liquid as formol, which is much used in keeping anatomical preparations precisely because it kills the tissues rapidly. A German scientist, M. Schultze, states that flies of the *Drosophila* genus resist the action of formol in a striking way, and he observes other remarkable cases, for instance hydrocyanic (prussic) acid vapors are exceedingly poisonous and will kill moths at once, but he finds that the zygotes are able to live in it, and even to develop. Jensen states that although the liquid in the pitchers of the nepenthe plant attacks and digests insects, he finds that three culicidæ will live in it unharmed, and they are protected against the digestive action by an anti-ferment which they secrete. Prof. Korschelt saw that larvæ of the common fly, when kept in a 2 per cent solution of chromic acid, could be transformed into pupæ and also into winged flies. Another German scientist, Prof. Schultze, received bottles from east Africa containing anatomical specimens preserved in formol, and he found a great number of larvæ and pupæ of the *Drosophila rubrostrata*. Fearing that they would attack the specimens, he poured in pure formol, but even this did not kill them. Other *Drosophila* are found to live in liquids which seem unfavorable for

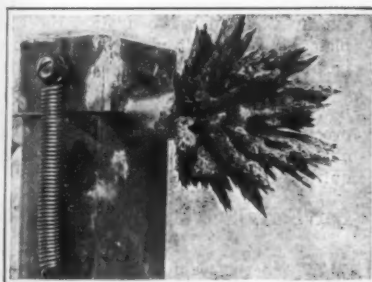


Fig. 5.—Small flat pole with air return.

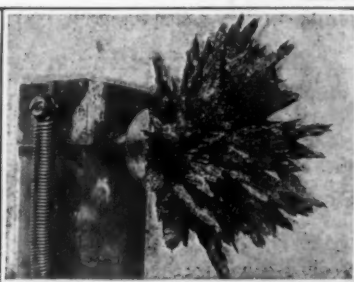


Fig. 6.—Enlarged flat pole with air return.

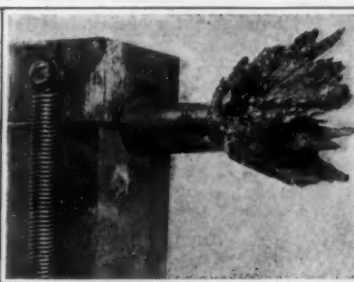


Fig. 7.—Rounded pole face with air return.

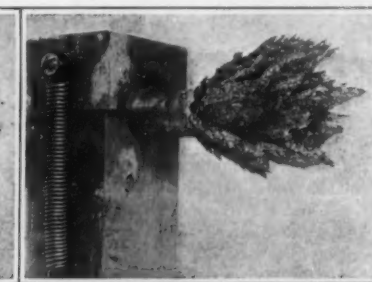


Fig. 8.—Conical pole face with air return.

these models, the same procedure was followed as in making Fig. 1; so that they virtually have made themselves, only so much of the material as we picked up by the pole itself being in the model. For this reason, their form may be considered a reasonably accurate representation of the magnetic field.

In Fig. 7 is shown a rounded pole face of small diameter. It will be seen that this has great intensity at the center and less at the sides, with only a slight tendency to radiate outwardly from the sides. This corresponds closely with what we know in regard to the effect of rounded poles for electro-magnets.

Fig. 8 shows a conical pole, having, as before, an air return. The extreme concentration of this form of pole is well shown by the length of the center spines and the close bunching of the whole mass around the center.

To confirm the last two results and to contrast them with each other, as well as to show the form of an intense field between two such poles, let us refer to Fig. 9. This model was formed in the same manner as were all the others, so that it, too, may be said to have built

tration at the middle and a greater tendency to radiate from the sides.

In Fig. 10 the contrast between the poles is still more marked. In this case we have a small flat and a conical pole, the model having been split open as before. It will be noticed that the structure is less dense in the center than was that formed by the rounded pole, while the tendency to radiate from the edges is greater, especially so in contrast to the con-

development of life, for instance, the *Dr. funchris* and others are found wherever there are substances in acid fermentation, such as in fruits, vinegar or beer. They lay their eggs here, and the larvæ find sufficient food, this consisting of spores, bacteria and fermented matter which appear at the surface of fermenting liquids. The *Dr. acetii* lives in apples or apricots which are in putrefaction, and the *Dr. pallipes* lives in the larva state in the sap which flows from cut places in the elm tree. Other unusual cases might be mentioned.

A Motor-driven "Mauretania"

BASED its estimate on the amount of fuel required by the "Selandia" of 2,500 horse-power, and assuming a consumption of 11½ tons of oil per day, the *Engineer* estimates that the "Mauretania" would require 313 tons of fuel per day, or 1,487 tons for a run across the Atlantic. It is estimated that if the "Mauretania" had a double hull, with one foot between the two skins, she would have storage space in her sides of about 56,240 cubic feet, which would be sufficient to contain the oil necessary to carry her across the Atlantic.

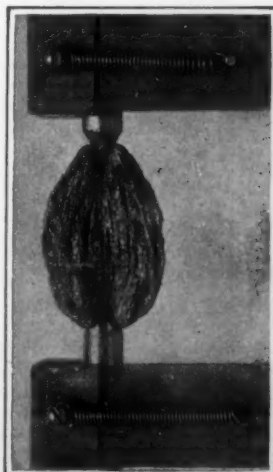


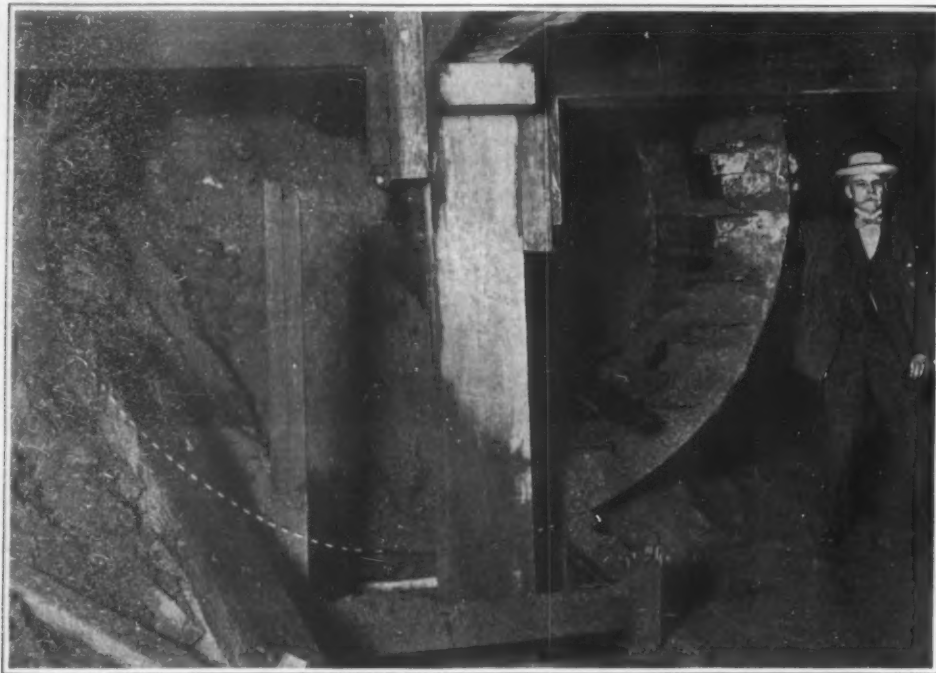
Fig. 9.—Field between rounded and conical pole pieces.



Fig. 10.—Field between small flat and conical pole pieces.



Fig. 11.—Field between enlarged flat and conical pole pieces.



Front of the Broadway Beach tunnel building shield.

Lower part of cutting ring at the right. The dotted line shows the contour and location of the concealed left portion.



Side of the shield.

To the left and right respectively are the cutting ring and building hood. Hydraulic rams in the center space, which was originally of wood.

Excavating the Beach Shield

DURING the excavation in the month of August last of lower Broadway under the supervision of the Public Service Commission of New York city for the building of the new Broadway and Lexington Avenue four-track subway, the engineers had to remove the smaller tunnel, 10 feet exterior diameter, built in 1869, located under the center of Broadway, opposite City Hall Park, and extending from the south side of Murray Street to the southwest corner of Warren Street on the north.

This tunnel had been constructed under the street at that early period without disturbing the surface or the traffic over head, as described in the SCIENTIFIC AMERICAN of March 5th, 1870, by means of the Beach hydraulically propelled cylindrical-shaped shield, built of wood and iron, the exterior diameter of which was of the same dimensions as the trailing tunnel or tube, or about 10 feet.

It was the invention of Mr. Alfred E. Beach, one of the original proprietors and editors of the SCIENTIFIC AMERICAN. Upon the request of Mr. Alfred E. Beach's son, Mr. Frederick C. Beach, now also one of the owners of the SCIENTIFIC AMERICAN, and the courtesy of the officials of the Public Service Commission, the contracting company was asked to refrain from demolishing the shield after it was dug out, with a view of its removal, preservation and restoration as a historical relic, it being the first machine of its kind to operate in tunnel construction work in New York city, and the forerunner of all the great shields used in the construction of the mammoth electric railway tubes now under the rivers about this great city.

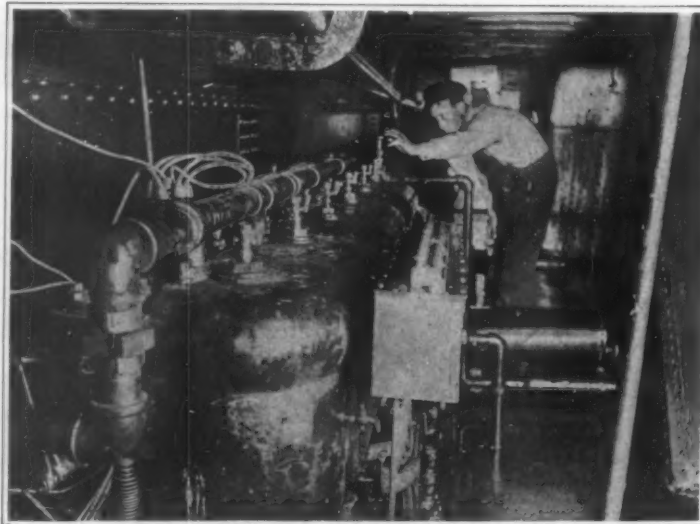
An inspection of the shield from the exterior as it lay partly imbedded in the sand, by Mr. F. C. Beach (who actively supervised the operation of it in 1869), disclosed the fact that in all these 43 years the iron and brass work, including the thin hood of iron on the rear, had remained in pretty good condition, but the wood staves between the front cutting ring and rear ring carrying the hydraulic rams and the cross front wood shelves had entirely disappeared and rotted away. The flashlight photograph, with Mr. Beach standing near the cutting edge, shows the one half of the front cutting ring with projections on its interior surface, to which was secured by bolts the ends of the thick transverse shelves for the purpose of preventing the inflow of loose sand. In the center is observed the timbers used by the contractors to support the present street planking over head as well as the electric street



A full side view of the all-steel interurban car ferry "Henderson."



This car ferry has a capacity of two electric passenger cars, a speed of 8 miles per hour, and is operated by gasoline power.



One of the gasoline engines of the car ferry power plant.

railway. The side view shows the side of the front cutting ring connected by inch stay rods to the rear of the hood-ram supporting ring, and between these rods at equal distances will be observed the cylinder ends of the hydraulic rams with bent tubing on the rear, which connected with the main supply pipes from the hydraulic pump. This was operated by manual power. The long thin cylindrical hood is attached to the rear piston ring and extends back from it some two feet or more. The pistons within the rams are forced out by water pressure against the completed tunnel, built up within the hood, pushing the shield forward through the sand to the extent of the hood; then a new layer of masonry is built and the process repeated. By this method only the quantity of earth is removed that is required for the tunnel to occupy.

Car Ferry Service Across the Ohio River

AN experiment in interurban railroad practice which has been worked out at Henderson, Ky., demonstrates the efficiency of gasoline power for use on car ferry work.

The "Henderson" is the first interurban car ferry ever built, and the first large car ferry operated by gasoline power. She is all steel; length over all, 120 feet; beam over all, 34½ feet; beam at water line, 25 feet. Her displacement when light is 88 tons, and loaded with two electric interurban cars, 150 tons.

Her power plant is two 54 horse-power "Buffalo" heavy duty gasoline engines, seven-inch bore and nine-inch stroke, with a normal speed of 350 revolutions per minute. Each engine drives one side paddle wheel, but there is additional gearing by which one engine can operate both wheels if desired. The motors drive the wheel shafts through large bevel gears at a ratio of 10 to 1. The side paddle wheels are 10 feet in diameter, three feet wide and have 20 blades 18 inches deep.

Economy was one reason why gasoline power was chosen for use on the "Henderson." While it takes her only six minutes to cross the Ohio River with the current, and an additional two minutes when going against the current, the "Henderson" is called upon to make only one round trip every hour. This means that most of the time she is standing idle at one side of the river or the other, waiting for her cars to arrive. With a steam plant this would mean a great waste, for coal would be consumed all the time the boat was at dock, but with gasoline engines, when the boat stops, the cost stops, there is no steam to keep up.

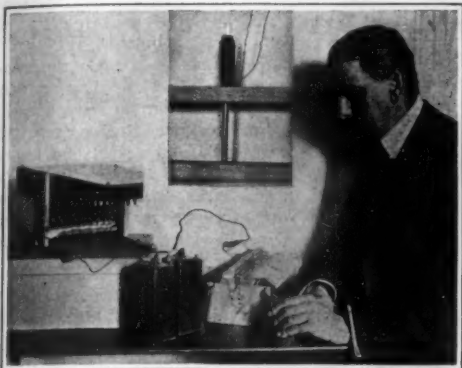
An Electric Harp

By F. H. Williamson, Jr.

BEING possessed of a three-bar auto-harp, of which the bar mechanism had been accidentally broken, it occurred to me that it might be arranged to be played by electric power.

My first intention was to have pickers for the strings as in a regular harp, but this scheme was abandoned, as too complicated, an arrangement for striking blows upon the strings, being substituted. Some experiments showed that the simplest plan was to use solenoids, that is, magnet coils with movable iron cores. How this was managed and the apparatus constructed, is shown in the accompanying illustrations.

Upon the harp *A* (Fig. 1) were screwed two upright side pieces *B* and *B'* with foot pieces *C* and *C'* to support the instrument in inverted position for play-



The electric harp in operation. A solenoid shown in the insert.

ing. Three strips, *D*, *G*, and *I*, of $\frac{3}{8}$ th stuff, $1\frac{1}{2}$ inches wide, were then cut out. The strip *D* was laid across the 21 strings of the harp, between the two uprights, and carefully marked where the strings crossed it. These marks were extended to the $1\frac{1}{2}$ -inch side, crossing two parallel lines drawn lengthwise on the strip, $\frac{1}{2}$ inch apart. A light mark was then made in the wood, with a center punch, at alternate points where the cross lines joined the parallel lines, "staggering" them, as it is called. At each mark, a $\frac{3}{16}$ -inch hole was then drilled perpendicularly through the wood, using a twist drill.

The solenoid coils were now wound upon 21 pieces of $\frac{3}{16}$ -inch thin glass tube, 2 inches long, the glass being nicked with a file and broken between the fingers. The winding was done thus: A bit of $\frac{1}{8}$ -inch brass rod 3 inches long was clamped in a vise, and one of the tubes slid upon it. A wooden crank was then forced temporarily on the glass, and the latter wound with four layers of No. 24 enameled copper wire, in a coil $1\frac{1}{2}$ inches long. The terminals were twisted together and the ends of the coils shellacked to prevent their slipping.

The free ends of the tubes were then set in the drilled holes in the wooden strip *D*, and glued securely, after which the strip was secured between the uprights, in such a position, that the ends of the solenoid tubes *E*, *E'*, etc., were one half inch from the harp strings, which show in the figure as a row of dots. One terminal of each coil was then scraped free of enamel and soldered to a common return wire *F*, terminating in a screw and washer on one of the side pieces, for a battery connection.

The strip *G* was then screwed between the uprights, close to, and at right angles with, the strip *D*. It was drilled to receive 21 round head No. 6 brass screws, one inch long, provided with washers. The screws were set in opposite sides of the strip, alternately, similar

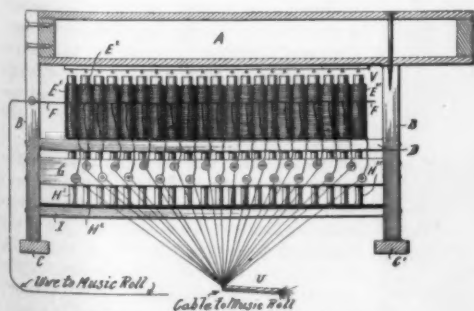


Fig. 1.—Front view of solenoids.

to the solenoids. The iron cores for the magnets were made from 3-inch wire nails of a size to just slip easily into the tubes. The heads were cut off, and both ends were filed flat, reducing the length to $2\frac{1}{2}$ inches. They were then set in place in the tubes, as shown at *H*, *H'*, etc., and the strip *I* upon which they were to rest, was secured between the supports, 2 inches below the strip

D, so that $\frac{1}{2}$ inch of the core remained in the tubes. The upper face of the strip *I* was padded with a four-fold thickness of cotton flannel, to reduce the noise of the dropping cores. A similar strip of flannel (*V*) was glued to the face of the harp, opposite the solenoids, to cut down the reverberation of the strings.

The keyboard and music roll attachment, shown in Fig. 3, consisted of a base board *J*, 13 inches long with upright sides *K*, *K'*, 5 inches high. The rollers, *L*, *L'*, were made of 12-inch lengths of 2-inch curtain pole, with $2\frac{1}{2}$ -inch heads *M*, *M'*, etc., turned from cigar box wood. They were pivoted at one end, on wire nails, driven into the centers; and revolving in holes drilled in the side piece. In the other ends were forced 2-inch cranks of $\frac{3}{16}$ -inch round brass rod *N*, *N'*, revolving in open slots in the side piece to allow the rollers to be easily removed. The slots were covered with small brass strips which could be turned aside to release the

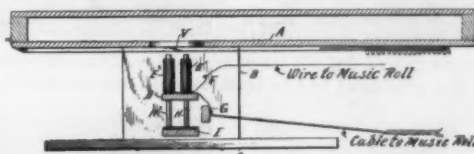


Fig. 2.—End view of solenoids.

rolls. A cross strip, marked *O*, was fastened to the top of the side pieces, just back of the front roller, and to this was secured a strip (*P*) of $\frac{1}{16}$ -inch brass $\frac{3}{8}$ -inch wide provided at one end with a screw and washer for the battery connection.

Half an inch back of strip *O* was placed a second cross-piece *Q*, of the same size as the former, but raised $\frac{1}{2}$ inch above it, on small blocks. One end of strip *Q* was hinged to the block and the other held down by the latch *S*. To the narrow edge of this strip were screwed 22 strips of light spring brass *R*, *R'*, etc., $1\frac{1}{4}$ inches long and tapering from $\frac{1}{4}$ inch wide at the large end to $\frac{1}{16}$ inch at the small end. The strips were clamped together in a vise, and drilled through the wide end in one operation with a hole large enough to take a No. 6 screw. The extreme tips of the narrow end were turned up slightly to avoid catching in the music roll, and the whole set fastened by screws to the strip *Q* in such position that the small ends pressed firmly upon the cross-strip *P*, and were spaced just $\frac{1}{2}$ inch apart.

The paper music was made from a strip of heavy wrapping paper, about 6 feet long by 12 inches wide. One end was cut V-shaped, the point being tacked to the center of the front roller, which was then turned over a couple of times to hold the paper firmly. The paper was then wound forward under the springs, and the notes and chords marked in pencil in a line with the corresponding springs. The bar *Q* was then thrown back out of the way and a strip of wood, sawed across the grain, was set temporarily beneath the paper at this point. This wood was 12 inches wide and $5\frac{1}{4}$ inches high, and was used as a support upon which the holes were punched in the paper at each pencil mark, using a hollow steel punch of $\frac{3}{8}$ inch diameter. The end grain of the wood allowed the punch to sink in, making a clean, round hole. Perforation for successive notes were spaced $\frac{1}{2}$ inch apart. The harp and keyboard were connected with No. 24 enameled wire, as the distance between them was only about 18 inches. For a longer distance No. 18 or 20 wire would be required. A wire was connected to screw No. 1 on the cross-piece *D*, Fig. 1, and the other end to the screw on spring No. 1 of the keyboard. No. 2 screw on the harp was joined to spring No. 2 with a second wire, and so on. The wires were then gathered into a cable *U* and taped together as shown. A battery of two or three dry cells was attached, one terminal going to the screw on the common return wire *F* and the other to the screw on the strip *P*.

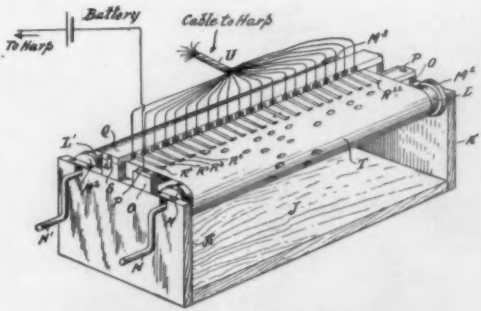


Fig. 3.—Music roll mechanism.

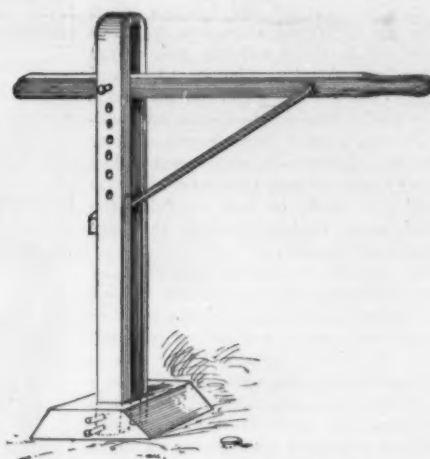
To operate the harp the crank of the front roller was turned to draw the paper forward, and as the perforations in the latter reached the various springs, they dropped down into contact with the strip below, throwing the current into the corresponding solenoids and drawing up the iron cores so that they struck the strings with a clear, sharp blow, dropping instantly as

the paper was drawn forward, and the current shut off. The best average speed for the roll was found to be about two longitudinal feet per minute.

A Simple Vehicle Jack

By James H. Armstrong

ONE of the simplest forms of jacks for use in lifting the bodies of wagons or other vehicles is illustrated in the accompanying drawing. The device can readily be made by any amateur and the construction is inexpensive. The uprights of the jack consist of a single length of iron $1\frac{1}{4}$ by $\frac{1}{2}$ inch, bent double or to hairpin form, with the lower ends secured in a block of wood measuring 2 by 6 inches. The ends of the uprights are fixed into recesses in the block, and are held in place by means of bolts as indicated by dotted lines in the drawing. The lever on which the vehicle



An improvised vehicle jack.

axle is supported is made of strap iron measuring 1 by $\frac{3}{4}$ inch. This is fulcrumed between the uprights by means of a bolt which passes through holes in the sides of the uprights. There are a number of such bolt holes to permit of adjusting the lever to various heights. The weight comes on the short arm of the lever and is lifted by depressing the long arm. To hold the long arm in depressed position a rod is provided which is fastened to the lever at one end, while the other end passes between the uprights and is welded to a block of metal. This is adapted to bear against the uprights and serves as a catch to hold the lever at any desired adjustment. The rod shown in the drawing is $\frac{3}{8}$ inch in diameter.

Lashing or Seizing Timbers Together

By Albert F. Bishop

TIMBERS from 7 to 10 inches in diameter can be bound together readily with wire about the size of that used in telegraph lines. The end of the wire is turned at right angles and fastened to the timber by a staple. The wire is then wound around the two pieces as tightly as possible from four to six turns. The end of the last turn is bent at right angles and fastened to the other timber by a staple. Now a small pointed bar is inserted in the center of the layers and



Method of lashing timbers together.

the layers are twisted several times as shown in the sketch. The writer believes two pieces could be bound together in this manner as tightly and firmly as the use of bolts could make them. This method requires very few tools and very slight expense for materials. This wrinkle can be applied to telegraph poles, flag staffs, or repairing fence posts, etc.

Inventions New and Interesting

Simple Patent Law ; Patent Office News ; Notes on Trademarks

Healing Broken Machinery by the Electric Flame

By Joseph B. Baker

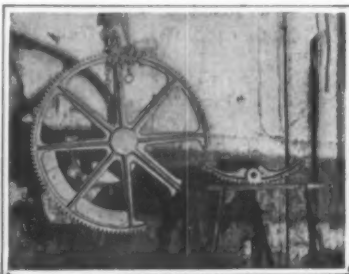
A **BROKEN** machine is only the picture of its real self. The machine is all there, but it is useless because of the break in some important part which destroys its strength. Now the unsound part may be healed and so reclaimed by the electric flame. The castings and forgings which make up large and expensive machines sometimes break in ordinary use, or are broken by accident, causing great loss, and delay to the work in which the machine is being used. The simple electric arc welding system, applied in an hour's work or more by a skilled man, makes such broken parts as good as new, no matter how "far gone" the crack, or how extensive the actual, open rupture through the very structure of the part.

For example, the motor shells and gear boxes of electric cars may become cracked by yielding to the fatigue of the metal in the ordinary operation of the car. Cracked motor shells were formerly either sent to the scrap-heap or else repaired by riveting a plate over the break. To send the part to the scrap-heap means practically throwing away an expensive steel casting on which perhaps, a lot of valuable machine work has also been done, and to repair the part by riveting is to fail to restore the original strength and rigidity. The same thing applies to the steel forgings of car-truck frames, parts of printing presses, or the part or forged parts of any good-sized machine. The need is, then, for some means of easily, quickly and inexpensively mending such broken parts.

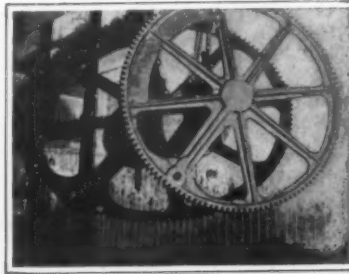
This need is filled in the electric arc welding process, which can be used on the spot, wherever direct electric current is available, and in a small space ten feet square. Arc welding reclaims the part at an expense which is very small compared with the cost of a whole new part, a cost which does not exceed the expense of the far less effective riveting. The occurrence of a bad crack, or of an actual break in a big, expensive casting or forging is the opportunity of the arc welder to make whole and sound again a piece which had seemed irretrievably ruined. Steel castings cost more than iron castings, and it pays correspondingly better to repair them by the arc welding process. They are just as easily healed as the latter, and it is something worth while to recover a steel casting for example costing \$500 with half a day's work at an expense of a tithe (or less) of the first cost of the piece.

By the use of a direct current of 220 volts or over all castings and forgings except brass, bronze or copper can be repaired by genuinely welding the break, using the arc to soften the metal adjacent to the break and then feeding in a piece of metal of the same or better grade to fill in the break and make the piece integral. If alternating current only is available, it may be transformed into the necessary direct current by the customary apparatus for this purpose, such as the mercury arc rectifier for relatively small work. The process is simple and rapid, but certain precautions are necessary. The operator's only tool is the carbon electrode in its holder, a hand tool with means for protecting the operator's hand and body from the heat of the arc. The head and body are protected by a canvas hood, and the eyes by goggles having several thicknesses of colored glass. The carbon pencil, $\frac{1}{2}$ inch to 1 inch in diameter, according to the size and shape of the work, is made the negative electrode, and the voltage is cut down to about 100 volts at the arc by a suitable adjustable resistance.

When the piece is once set and aligned, and the current turned on, the work pro-



Mending a broken gear: a difficult job of arc welding. The gear teeth at the break were saved. The alignment had to be maintained exactly during the welding.



A mended break that extended from above the armature bearing to the gear-shaft bearing.



The arc welder at work on a railway motor shell. In practice the arc used is somewhat shorter than in the illustration.

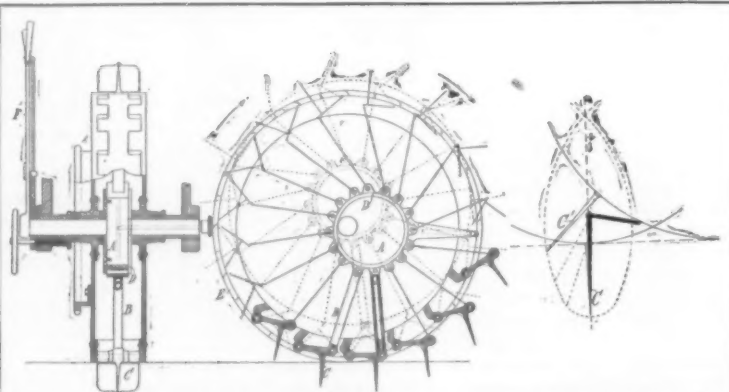


Fig. 1.—Front and side views of traction wheel with retractable blades.

Fig. 2.—Paths of fixed and retractable blades.



The new traction wheel driving a plow through an alfalfa field.



Plowing a rice field; a supreme test for the traction wheel.

ceeds with marvelous rapidity. The searching and penetrating heat of the arc easily softens metal shells of the ordinary thickness found in the structural castings of machinery or in the main or minor moving parts of the same, up to 4 inches; the $\frac{1}{2}$ -inch to $\frac{3}{4}$ -inch thickness of a motor shell is quickly brought up to welding temperature necessary for a true union of the parts. If overheated by the intense play of the arc the metal runs like wax, and here is where skill and special manipulation of the powerful tool is required.

It is better of course to apply the welding process to pieces when they are first found to be cracked, or to have a crack starting, from some habitual or repeated stress or an accidental shock, and before they become broken away entirely: "a stitch in time saves nine." In some cases there is opportunity to make the work even better than new by welding upon it strengthening or reinforcing parts.

A Novel Italian Traction System

MOTOR-DRIVEN agricultural machines operate with difficulty over ground strewn with straw or other material of a slippery nature. In order to give the driving wheels an adequate purchase on the ground they must be made very heavy and must be provided with cleats. This adds a material load for the engines to drive and is entirely unnecessary in the opinion of two Italian inventors who have devised the traction wheel illustrated in the accompanying engraving. In place of cleats the traction wheel is provided with long blades, designed to dig into the ground. Whenever desired the operator may retract these blades, so that the machine can travel over an ordinary road without injury to the road. The construction of this wheel is illustrated to the best advantage in Fig. 1. The axle of the wheel carries an eccentric A, on which is mounted a strap connected by rods B, with the traction blades C. As the traction wheel revolves, the eccentric A remains stationary, but the strap D must revolve with the wheel and consequently the traction blade must assume the positions shown in the drawing. It will be observed that in the forward half of the wheel the blades project from the periphery of the main wheel rim E. The blades are pressed into the ground by the weight of the wheel, but are immediately retracted after passing the point of contact of the wheel with the ground. As the blades are retracted in a vertical direction they do not serve to scoop holes in the ground as would fixed cleats of the same depth. Fig. 2 shows in full line the cut in the ground made by the blade that is retractable, while the dotted lines show the large hole in the ground that would be scooped out by fixed blades projecting from the rim of the traction wheel.

When it is desired to run the traction wheel without projecting the blades into the ground, they may be moved to a different position by operating the lever F, so as to throw the eccentric A to the position shown by dotted lines in Fig. 1. Then the blades will project from the upper half of the wheel and will be withdrawn in the lower half where the wheel comes in contact with the ground. One of the accompanying illustrations is a photograph of the machine operating through a rice field. Here it is put to an extreme test for the reason that the field is flooded with water, and affords very little purchase for a traction wheel. Another picture shows a plow equipped with a traction wheel of the new type, operating in an alfalfa field. The new type of traction wheel affords an ideal hold on the ground and permits of reducing materially the weight of agricultural machinery. Furthermore, the ability to regu-

late the depth to which the blades will sink into the ground and to retract them completely if desired, is a very important advantage.

The Trade-mark as a Business Asset

By W. E. Woodward

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[T]HE average business man has only the vaguest notion of the value of a trade-mark. He does not realize that it is very often the connecting link between the producer and the ultimate consumer; that it is a symbol of good will, a tangible asset with a determinable money value; that it must be chosen and applied not in a haphazard way but with a due regard for its psychological effect upon the public. Nor does he realize the importance of complying with the statutory requirements which secure to him a property right in a trade-mark comparable with the property right that an inventor acquires by taking out a patent.

The following is the last of a series of articles, written by a man who is at once a trade-mark, an advertising, and a business expert, a man who has a first hand knowledge of the value of trade-marks and of the correct methods of trade-mark exploitation. The series, which will be eventually published in book form, included discussions, written in business English, of the Federal trade-mark law, analyses of the requirements for registration, the elements of a good trade-mark, and trade-mark protection.—EDITOR.]

An Ingenious Similarity of a Trade-mark.

—IX.

(Concluded from page 184, August 31st, 1912.)

An infringing mark may be so nearly like a well-known and valuable trade-mark that the unwary or careless may be deceived, yet, at the same time, it may be so dissimilar that a show of defense may be made. The National Biscuit Company has prosecuted more than five hundred infringements of its trade-marks. "Unecuda" Biscuit has been imitated by "Ulika," "Uwanta," "Iwanta" and dozens of other specious wordings.

The mark "Yusea" used on incandescent gas mantles, was infringed by "U-C-A." In this case there was no similarity whatever in the appearance of the marks, but evidence was produced to show that "Yusea" was pronounced "You see a," and that in sound the marks were precisely the same. Priority of registration of the "Yusea" mark was proved and the use of "U-C-A" was accordingly enjoined.

The word "Chasseuse" was held by the court to be an infringement of "Char-treuse"—both marks being applied to cordials.

"Grape Nuts," a cereal food, was not infringed by "Grain Hearts." "Old Crow," the name of a whiskey, was not infringed by "Old Jay."

On the other hand "Colonial Dame" used in connection with perfumery, was infringed by "Colonial."

"Chatter-Box," an annual publication for children, was infringed by "Chatter-Book," used as the name of a publication of the same general appearance and purpose.

The Right to Use One's Name and Its Limitations.

A typical case of this kind is that of Royal Baking Powder Company v. Royal (122 Fed., 337-1903; 58 C. C. A., 499-500). An individual by the name of Royal went into the business of manufacturing baking powder. His product was sold in packages of the same general appearance as those containing the product of the Royal Baking Powder Company. The court held that the respondent could use his own name, but "in the least conspicuous manner possible consistent with the right to place his name and address upon the goods made by him."

A similar case is that of Von Faber v. Faber (124 Fed. R., 603). In this case the plaintiff, a manufacturer of lead pencils, was the owner of a business founded in 1761. The pencils made by this firm had always been marked "A. W. Faber." The defendant, also named Faber, began to manufacture pencils in the United States,

affixing to his product the mark "Faber." The court held that this was an unfair use of his name, and while he had a right to use his own name, yet he must prefix to it "John E." "Eberhard" or "John Eberhard."

The well-known chocolate manufacturers of Dorchester, Mass., Walter Baker & Co., have had to contend with many individuals bearing the name of Baker. In each case the decisions of the court have been to the effect that any Baker has a right to manufacture and sell chocolate, and to use his own name on packages of his product, but his name must be accompanied by some statement or distinguishing mark which will clearly differentiate his product from that of Walter Baker & Co.

In the case of Williams v. Mitchell (106 Fed. R., 168-171) the court said: "One may not use his own name for such purpose when it works a fraud. If he uses a descriptive word, or a geographical name, or his own name, it must be so used as not to deprive others of their rights or to deceive the public, and the name must be accompanied with such indications that the thing manufactured is the work of the one making it as would unmistakably inform the public of the fact."

Casual Resemblance Is No Infringement.

A manufacturer of a lantern known as a "Hurricane" lantern claimed that the name of another lantern, called "Tempest," was an infringement. The court held that while there was a resemblance in the names in the underlying idea, they were so different in appearance and sound that any person of average common sense would not mistake one for the other.

"S. B.," a trade-mark for cough drops, was not infringed by "B. and S."

"Weber," a mark for pianos, was not infringed by "Webster." In this case there is a casual resemblance in appearance in the two words, but no resemblance or very little, in sound.

The Plaintiff Must Come Into Court With Clean Hands.

The courts will not use their power to perpetrate a fraud. A trade-mark conveying a misrepresentation of the composition, character or quality of the goods with which it is used, cannot be protected against infringement.

How Legislators View Patents

THE debate on August 7th in the House of Representatives upon the question of appropriating ten thousand dollars to investigate the Patent Office, developed some interesting statements from different Congressmen. Chairman Oldfield of the Patent Committee said, "the Patent Office has taken in and turned into the Treasury about \$7,000,000 more than it has taken out of the Treasury." In speaking of the great corporations, who are said to take men out of the Patent Office, the same gentleman said: "They want men who have started at the bottom in the Patent Office and have worked themselves up to the Commission or assistant Commissionership." If they want such a man, we do not recall an instance in which they got one, as ordinarily the force of such companies is recruited from the assistant examiners of the Patent Office.

Congressman Mann said, he thought the salaries in the Patent Office ought to be increased, but asked if Chairman Oldfield did not believe the Government would never be able to compete with salaries offered by outside people. Congressman Bowman remarked: "I have had some business with the Patent Office and the work that they have done for me, has always been efficient." Mr. Bowman also said: "Ease in securing a patent is, I believe, of great advantage to the country," and further "I consider as one of the greatest assets of this country the inventive genius of its people. I do not favor the suggestion of the committee, that there might be a slight advance in Patent Office fees. They should be kept low and every encouragement and assistance given inventors."

Referring to the bill to codify the patent statutes upon which hearings have been had this year, Chairman Oldfield said, "a substitute for that bill will be reported to the House in a few days, but it is not believed that it will be possible to discuss the bill or pass the bill at this session." This appears to settle the question as to any revision of the patent laws at this session of Congress.

In the course of the debate, Chairman Oldfield referring to the compulsory license of the proposed new law, pointed out that it differed from other laws of the kind in that it did not apply to the original inventor, but only to those corporations or persons who acquire patents for the purpose or with the result of stifling competition.

Speaking of the bill about to be introduced, Congressman Lafferty said, as he understood the bill, it would make it a penal offense for the owner of one patent to buy another patent with the intention of restricting or interfering with its manufacture or sale, and Chairman Oldfield replied that such was the intended result.

With reference to the Sherman anti-trust law, Mr. Oldfield announced that a great many of the best patent lawyers in the country to-day, take the position that the law does not apply to patent monopolies, but that the proposed bill will provide that the law shall be applicable to those monopolies created by the accumulation of patents.

Included in the debate was a brief discussion as to the constitutionality of deputizing to a court the fixing of a license fee, Congressman Cooper asking whether such fixing was a judicial function and suggesting that a court cannot fix the rate, but it can decide whether the rate is confiscatory or not. At any rate, Chairman Oldfield said the bill is not to be pressed for passage at this session of Congress.

Notes for Inventors

Four Glass Drawing Patents.—Four patents, numbered from 1,034,445 to 1,034,448, inclusive, have been issued for the inventions of Mark J. Realy of Bradford, Pa. The inventions relate particularly to devices in connection with glass drawing apparatus and to the ring shields and fenders operating in the tanks of such apparatus.

Wanted: An Artificial Bait.—John W. Hurley, is well known among Washington city fishermen, for his skill with the rod and reel. A recent issue of the Washington Star says, that Mr. Hurley thinks it about time that some one invented an artificial bait for salt water fish and quotes the veteran angler as saying:

"Peelers make fine bait, and soft crabs are not bad, but usually it is hard to get them at places, where there is a chance to make a good catch. Some of the fishermen laughed at me, when they saw me taking soft crabs from the city for bait, but when they reached the fishing grounds, they were sorry they hadn't invested in some of them in the city."

A Moth-proof Fly Book.—A patent has been granted to F. J. Cooper of San Francisco, Cal., for a fly book which should be of interest to fishermen. The inventor, when he first started out in his career as a fisherman, bought everything that was recommended as needful. A generous assortment of expensive flies formed part of his equipment. He found that the flies lasted just one season. When springtime came he went to his kit and was amazed to find that the moths had cleaned his books of dozens of flies. That inspired the idea of a moth-proof fly book. The result is a book that is moth-proof, in which there is no metal in contact with the hooks, which is dust-proof and damp-proof. A celluloid window on the top of each of the envelopes constituting the leaves, permits the user to see at a glance just what fly he wants. The book is made on the loose-leaf principle and holds twelve to fifty-four dozen flies.

An Electrically Conductive Ink.—Two patents, Nos. 1,034,103 and 1,034,104, have been granted for the inventions of Hyman Eli Goldberg, wherein he provides a visible

writing ink having as one of its constituents a good electric conductor so that the ink when applied to the paper by an ordinary writing pen and dried can be used to conduct electricity along the characters thus produced upon the paper.

The Patent Medicine Situation in England.—A committee of the House of Commons has, for some time past, been holding sessions in London for the purpose of investigating the law regarding the sale and advertisement of patent medicines in the United Kingdom.

In the course of the investigation, it has been developed that the sale of such medicines is equivalent to one package per year for every man, woman and child in the country; that as estimated by one witness, the amount of money spent on proprietary medicines in Great Britain alone in one year amounted to \$12,166,250 or sufficient to maintain 40,000 hospital or sanatorium beds and that notwithstanding the enormous amounts expended, the solicitor to the customs and excise department stated, in answer to question from the chairman of the committee that there was nothing, in his opinion, in the law as it now stood to prevent any person making up any sort of mixture containing anything except obvious poison, from advertising it as a cure for any disease, and selling it to the public on payment of the stamp duty. He added that probably the police could prosecute if absolute fraud were established, but that it would be exceedingly difficult, in his judgment, to obtain evidence that would insure a successful prosecution.

Legal Notes

Patentability Not Involved in Interference.—The Court of Appeals of the District of Columbia in the interference case of Putnam v. Wetmore and Niemann, has held that the question of the patentability of the issue of an interference, will not be considered by the Court of Appeals and says, quoting a number of other cases: "In interference cases we do not determine whether either party shall receive a patent. The question presented to us is, conceding there is a patentable invention, which party was the first to invent or discover the same."

Reasonable Doubt as to Similarity.—The Commissioner of Patents, in the case of J. & Riley Carr v. The William Schollhorn Company v. Warren Ax & Tool Company v. Geo. H. Bishop & Co. v. Radigan, Rich & Co. v. Draff v. E. C. Atkins & Company, has held in a trademark case that where there is a reasonable doubt whether there is deceptive similarity between the mark of an applicant and that of a prior registrant, and the consent of the registrant to the registration by the applicant of his mark is secured, that the doubt should be waived in favor of the applicant and his mark registered.

A Decision Affecting Absinth.—The Board of Food and Drug Inspection of the Agricultural Department has issued a decision, No. 147, under the section of the Food and Drugs Act which forbids the importation of any food or drug which is "of a kind forbidden entry into, or forbidden to be sold or restricted in sale in the country in which it is made, or from which it is exported," and also of any food or drug which is "otherwise dangerous to the health of the people of the United States," calling to attention that importations of absinth into the United States, are prohibited, both because they come from countries which forbid or restrict its manufacture and sale, and because these products are injurious to the health of the people of the United States. The decision holds that the Secretary of Agriculture will regard as adulterated under the Food and Drugs Act absinth which, on and after October 1st, 1912, is manufactured or offered for sale in the District of Columbia or the Territories, or shipped in interstate commerce or offered for importation into the United States. The effect of this decision upon trademark registration is somewhat problematical, especially as to the marks, should there be any, applied to absinth manufactured in this country and designed for export.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

BELT BUCKLE.—L. SANDERS, 621 Broadway, New York, N. Y. A highly important result obtained in this construction is the rigidity between all the parts of the base of the buckle, the arrangement being such that rigid relation is maintained between the means for fastening the buckle to the belt and means for adjustably making connection between the free end of the belt and the front end of the buckle.

DRESS.—D. ZAVODNIK, 49 Walker St., New York, N. Y. This invention relates particularly to a lady's house dress, and an object is to provide a dress which will be neat in appearance about the waist, avoiding the objection raised to the loose fitting morning dresses, and which will adhere to the waist of the wearer, irrespective as to whether or not corsets are worn.

Pertaining to Aviation.

FLYING MACHINE.—T. W. CARRY, JR., 809 Canal St., New Orleans, La. It is the object of this improvement to provide a flying machine with one or more sets of equilibrium planes and ailerons adapted to counteract the tilting action and to reduce the inverse angle, whereby shorter turns may be accomplished with less danger.

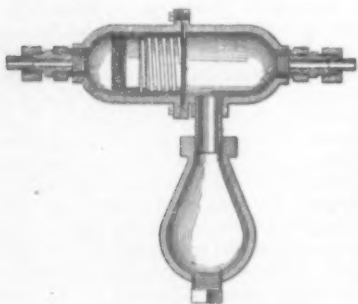
FLYING MACHINE.—C. A. HAMILTON, Box 421 Sag Harbor, N. Y. An object here is to provide a machine of the helicopter type with a plurality of propellers, and means for directing the line of action of said propellers so as to traverse the machine in any direction; also a machine with a plurality of helicopter propellers, with means for throwing into and out of operation any one of the propellers.

Of Interest to Farmers.

CRANK HEAD FOR MOWING MACHINES.—L. R. WHITESIDE, R. F. D. No. 6, Belleville, Ill. A purpose here is to provide a crank head with a crank pin sleeve having a plurality of pairs of trunnions interchangeable with the pitman, so as to take up the wear and obviate irregularities in the movement of the mechanism, so as to prevent excessive jarring.

Of General Interest.

GASOLINE FILTER.—J. C. KEATZEL, 45 W. 83d St., New York, N. Y. This invention pertains to a new form of gasoline filter, and an object is the provision of a device of the above indicated character from which the water or other heavy substance will be baffled and precipitated from the gasoline before



GASOLINE FILTER.

the latter passes through the screens common to devices of this character. From this device the screens may be readily removed and inserted. A further object is to provide a device which may be readily cleaned and in which the several parts may be quickly assembled or removed. The engraving pictures a vertical sectional view of the filter.

FILTER.—E. BEAVER, Manhattan, N. Y., N. Y. This invention relates to a filter for filtering any desired liquid material, such as sugar solution, water or petroleum. Means are provided by the invention whereby the sediment and foreign particles filtered out from the liquid can be collected in a catch-basin and at suitable intervals removed from the filter.

BRACKET FOR CARD HOLDERS.—J. A. MANSON, 347 W. 87th St., Manhattan, N. Y., N. Y. In the present patent the improvement has reference to a bracket for pivotally mounting holders for display cards, and an object of the invention is to provide a simple inexpensive holder for card plates so that the latter may be readily and quickly dismantled from the bracket.

Hardware and Tools.

RIVET CALKING TOOL.—J. WOODWARD, Box 206, Leetonia, Ohio. The aim of this inventor is to provide a new rivet calking tool, which is simple in construction and arranged to permit a ready change in the calking hammers and guide for the use of the tool on different forms of rivet or bolt heads, with a view to calk or tighten the rivet or bolt.

APPARATUS FOR SPLICING ROPES AND CABLES.—H. H. WILSON and H. H. ROSS, Box 377 Nassel, Wash. The object of this improvement is to provide a conveniently portable apparatus, by means of which the ends of ropes and cables may be securely held while being spliced, and also to provide means whereby sufficient pull may be exerted on the spliced strands to draw them into position in the splice.

Heating and Lighting.

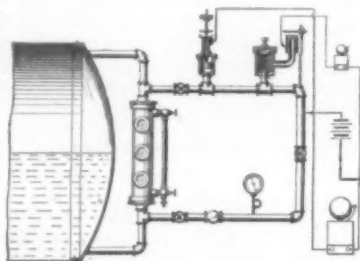
MATCH.—G. W. CURTISS, Blackwell, Wis. This match is a substitute for the wooden one and usable in the same manner by striking against any friction surface. A solid metallic body is provided having at its forward end a pocket extending axially a short distance, producing a tubular formation at the striking end. In this pocket is packed an absorbent



METALLIC MATCH.

such as absorbent cotton saturated with kerosene or other inflammable fluid. Over the end of the filled pocket and the end of the tubular shell thereof is affixed a striking head to cover the absorbent and shell in a way that the composition constituting the tip firmly adheres to the absorbent and to the shell, more particularly the former, by filling the interstices of the filling at the forward end of the pocket. The upper sketch is a perspective view and the lower a longitudinal section.

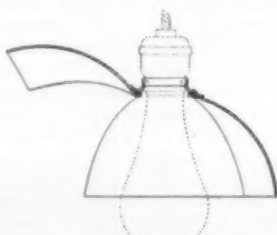
ALARM SOUNDING DEVICE.—R. A. GARCH, R. F. D. No. 1, Box 163, Seattle, Wash. The object of this invention is to provide a device which will in all cases sound an alarm when the pressure communicating therewith falls below or rises above predetermined points, the device being so constructed that the alarm may be sounded at



ALARM SOUNDING DEVICE.

any points desired relatively to the device. Another object is to provide in connection with the said device means to afford communication with the atmosphere to reduce the pressure when the pressure reaches a point where the alarm is sounded. The illustration shows a side sectional elevation of the invention, showing how it is connected with the boiler.

LAMP SHADE.—N. B. MCGHEE, Clifton Apts., 231 N. Broadway, Los Angeles, Cal. The object of this invention is to provide a shade for lights or lamps, more particularly for incandescent electric light bulbs, so constructed and arranged that it may substantially or entirely conceal the light, or be adjusted to reflect the light downward, or while shading the greater portion of light, enable the light to be projected and reflected in a particular direction. The device may be used for warming hands; or in the sick room, placed in bed for warming feet and other parts of the body. Hospitals will find this shade of value in doing away with paper pinned



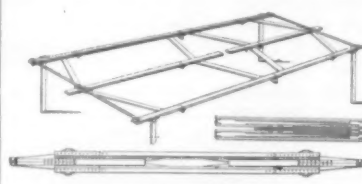
LAMP SHADE.

around lamp bulbs. The engraving illustrates one of the wings raised to reflect light in a particular direction.

Household Utilities.

CURTAIN STRETCHER.—H. MORLEY, 15 Edwards St., Patchogue, N. Y. This stretcher is arranged to fold with a view to provide a comparatively small bundle for conveniently storing the stretcher when not in use and to allow quick and accurate adjustment to accommodate curtains of different sizes. For this, use is made of side rails, adjusting bars intermediate the said side rails, pairs of links connecting the adjusting bars with said side rails, slides slidable on the adjusting bars,

and end spacing bars pivotally connected with the said slides and adjustably connected with



CURTAIN STRETCHER.

the side rails to hold the latter spaced the desired distance apart. The engraving shows a perspective view of the stretcher extended ready for use; a plan view of the stretcher folded; and a side elevation with the parts in folded position.

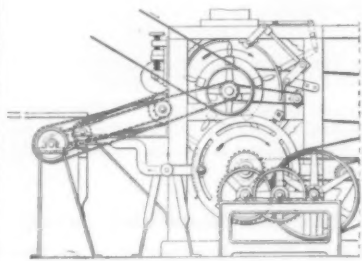
COVER FOR IRONING BOARDS.—T. M. BROOKMAN, 762 Spaulding St., Elmira, N. Y. The intention here is to provide a cover for an ironing board arranged to permit plain ironing, ironing of flange or lace, and to allow of readily placing the cover in position on the board or removing it therefrom.

Machines and Mechanical Devices.

ADDING COUNTER.—W. F. MULLANEY, Box 635, Marshall, Minn. This device will accurately measure the travel of a reciprocating element. In counters now in common use, it is not possible to accurately measure the travel of a reciprocating body, such as a piston rod of a pump, due to the fact that the counter does not register until the entire stroke has been made.

AIR WASHER.—M. S. KING, care of Wells & Newton, Ave. B. 17th and 18th Sts., New York, N. Y. The object here is to provide an air washer which will thoroughly cleanse and humidify the air used in heating and ventilating plants, the washer being constructed with a hollow shaft, supported at one end by the shaft in the blower, which is freely disposed in the hollow shaft, which is disposed in and is keyed to the hollow shaft.

BLEND MAKING MACHINE FOR STAPLE GOODS.—A. I. GERRY, Sanford, Maine. By this mechanism mixing and blending are done with a minimum of hand work, the material being thoroughly intermingled and cleaned during operation, the action being such that the material is fed into the machine in charges of predetermined size, these charges being admitted at intervals when various movable parts



BLEND MAKING MACHINE.

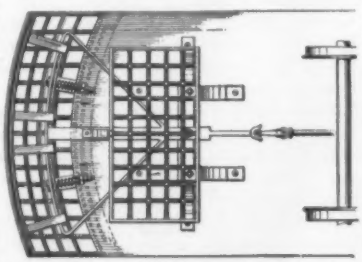
are in position for the charges to be taken in. Mixing and blending can be better done if the material is first operated upon in the mixing chamber and thence transferred to another mixing chamber and there operated upon under somewhat different conditions. The view shown is a fragmentary side elevation, and shows the first mixing chamber and parts associated therewith.

Pertaining to Recreation.

TOY AEROPLANE.—A. S. HECHT, 64 W. 88th St., Manhattan, N. Y., N. Y. This invention relates to toy aeroplanes, and the aim is to provide one which may be constructed at trifling expense, so that the aeroplanes manufactured in quantities, and may be given away for advertising purposes or to be sold for a few cents.

Railways and Their Accessories.

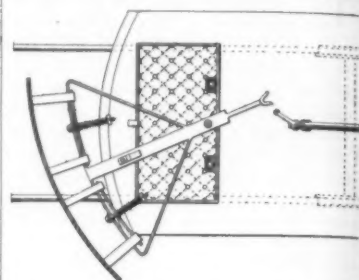
CAR FENDER.—C. B. MARTIN, Room 18, Cambridge Bldg., Portland, Ore. This invention relates to car fenders, and the object is



INVERTED PLAN VIEW OF CAR FENDER.

to provide one which is mounted for travelling on a rail secured to the car, locking means being provided for holding the fender in normal position until it is pressed rearwardly,

when the locking means are freed and the fender is moved to the side which has come in contact with the obstruction which has pressed it rearwardly. Springs are provided to assist in moving the fender to one side. It provides a pivoted apron, which is normally disposed in a horizontal position, but which is permitted to drop when the fender is moved to either side. The first illustration shows an

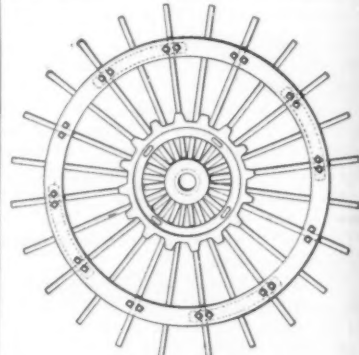


SECTIONAL PLAN VIEW OF PIVOTED FRAME, ETC.

inverted plan view of the fender mounted on a car; and the second is a sectional plan view showing the pivoted frame, the apron disposed thereunder, the mat, and the means by which the last is connected with the pivoted frame.

Of Interest to Farmers.

WHEEL.—J. E. McWILLIAMS, Hitchcock, Okla. This invention relates generally to wheels, and more particularly comprehends a traction wheel, especially intended for use on farm implements, for field work in especially plowed ground. The principal object is to provide a traction wheel especially adapted for use on farm implements, the wheel comprising a number of staggered spokes adapted for



TRACTION WHEEL FOR FARM USE.

engagement with the ground whereby the implement may be drawn thereover. This invention overcomes the disadvantages following the use of a rim wheel; the wheel involves a number of radiating and staggered spokes adapted for engagement with the ground, thereby avoiding the packing of the ground after being furrowed by implements having flat rim wheels. The engraving shows a side view of the wheel.

Designs.

DESIGN FOR A LAMP CLUSTER.—J. D. ROSS, Seattle, Wash. This ornamental design for a lamp cluster when mounted upon a pole, standard or other support, presents an elegant cluster of five globes in a line, the upper three of which rest on a base, while the two remaining and outer ones hang from the ends of the form constituting the fixture. The three upper globes are somewhat larger than the lower ones.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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(12675) E. W. asks: Can you kindly tell one of your readers what is the best heat insulation which can be easily obtained for the insulation of a fireless cooker? A. No complete insulation of heat is possible. Wool is the best which can easily be obtained. Asbestos is good. Such substances act to retain heat because they prevent the circulation of the air and thus convection currents cannot be set up, transferring the heat from the hotter to the cooler surface. This is the philosophy of the action of a thermos bottle, in which a vacuum is formed between the glass bottle inside and the metal covering outside.

(12676) A. M. asks: Can a man exert a greater downward pull than his own weight, irrespective of the position that he may take? A. When exerting a steady downward pull on a rope in a vertical direction, a man cannot pull more than his own weight. He will then leave the ground and raise himself into the air. He may exert a much greater downward force on a rope than his own weight by giving a jerk. By means of velocity and inertia he greatly increases the pull upon the rope.

(12677) C. M. A. asks: 1. Are there any theories advanced in regard to size and shape of an atom determining an individual element, and differing for each element, with a probability of all elements being a simple substance of matter? A. We doubt if anyone holds that the size and shape of an atom determines the kind of matter directly. It is held by many that the difference between atoms lies in the number of electrons which they contain. The hydrogen atom, which is the smallest, contains about 800 electrons. Scientists who hold this view will conclude that all the elements are derived from one form of matter. Perhaps they would say that the parent of radium is that primal form. 2. Does not the molecular or atomic arrangement have the larger part in the making up of an organic compound? A. There seems to be no reason for saying that the atomic arrangement is any more important in organic substances than in inorganic substances. You will find two books of especial interest in this direction: Duncan's "New Knowledge," price \$2, and J. J. Thomson's "Electricity and Matter," price \$1.25. From these books you will get the modern view.

(12678) J. A. S. asks: As I have bought almost everything I have read about on the construction of induction coils, have not yet got what is most essential; in fact, everything I have seen or read does not give enough information for the average amateur, leaving too much for the experimenter's imagination. I now have purchased 18 pounds of No. 36 wire and wound two coils carefully, one with cotton, the other with silk insulation. The cotton-wound coil has 48 double sections and the silk coil has 56 double sections, neither one giving more than a 6-inch spark. I do not know why, and cannot get the information anywhere. Possibly you could help me. Can you give me the address of some one or firm that I would be likely to get the information wanted? A. You have taken the very best course for finding the best method of making an induction coil, in buying Collins' book, which tells the whole story, from beginning to end, leaving nothing to the imagination. We cannot refer you to any better source of information. No firm making coils will give you advice. An induction coil is the result of an evolution by experiment. The man who has produced a form which gives good results will not publish the points in which his success lies. The book by Collins is the first effort to cover the subject of design for all sizes up to a coil giving a 12-inch spark. We think it quite reliable. Of course, there are many variations from his design, which might give good results. It is an old rule that you ought to get an inch of spark for each pound of secondary wire. Your coils are not up to this.

(12679) W. C. B. asks: As a disinfectant (inexpensive) for garbage can is air-slaked lime effective? Does it become inert when exposed to the air? Is charcoal a deodorant? What is your opinion of this formula: 3 pounds iron sulphate, 3 pounds slaked lime, 4 pounds road dust? A. Chloride of lime is a much better disinfectant than air-slaked lime for a garbage can or other domestic use. Charcoal acts as a disinfectant by absorption. It takes gases into its pores and thus removes odors from the air. If the charcoal is then burned the bad gases with their odors are destroyed. In the formula which you send iron sulphate is the active material and is one of the best disinfectants. The road dust serves simply as a vehicle to carry the iron sulphate. The slaked lime has some value but not so great value as many other germicides. For many formulas of high value for disinfectants we would refer you to our Cyclopaedia of Receipts, price \$5.

NEW BOOKS, ETC.

THE SUN. By Charles G. Abbot. New York and London: Appleton & Co., 1911. 12mo.; pp. xxv, 448. Price, \$2.50.

This is a book that was needed, and it has been written by the right man.

Hitherto the standard work in English on this subject has been Prof. Young's "The Sun," the latest revision of which appeared sixteen years ago, and is now out of print. Since it was published, at a time when solar physics was just beginning to be recognized as a field of research worthy of the whole time and attention of a numerous body of workers, this branch of science has made great progress, the record of which is scattered through a long file of the *Astrophysical Journal* and other kindred periodicals. Building upon Young's admirable treatise as a foundation, Mr. Abbot has given us a most welcome digest of all that is known to-day concerning the sun. As to the competence of the author, probably few of our readers will need to be told that he was Langley's assistant at the Smithsonian Astrophysical Observatory, and now, as director of that institution, is the world's foremost investigator of the problems of solar radiation.

The book is quasi-popular; i. e., it avoids the intricacies of mathematical physics on the one hand, but on the other can hardly be read to the fullest advantage by our friend in the street. The following are the chapter heads: I. The solar system. II. The Sun's distance. III. Dimensions. IV. The Instruments and Methods Used in Solar Investigation. V. The Photosphere. VI. Eclipses and the Outer Solar Envelope. VII. Sun-spots, Faculae and Granulations. VIII. What is the Sun? IX. The Sun as the Earth's Source of Heat. X. The Sun's Influence on Plant Life. XI. Utilizing Solar Energy. XII. The Sun Among the Stars.

Comparing Abbot's book with the earlier literature on the subject available to persons who read only English (Pringsheim's "Physik der Sonne" has, of course, brought the matter fairly up to date in German) we find that a great deal of information formerly given in a vague and tentative way, is now stated as *res judicata*. The spectro-heliograph, for instance, has cleared up a great many problems. The solar constant—which is fundamental in meteorology and geophysics, and the exact determination of which has been an urgent desideratum of these sciences—is at last definitely stated to average 1.95 calories (it is subject to some fluctuations) and Abbot's own work makes this value completely trustworthy. All other existing reference books and text-books in English give either a considerably higher value, or present the values obtained by numerous investigators, ranging from 1.76 to 4.06, leaving the student very much at sea as to the most probable one.

Recent advances in the measurement of solar radiation have, of course, been conditioned by the improvement of pyrheliometric apparatus, and there is probably still some work to be done in this direction. The author gives us a description of the Angström instrument—which was somewhat rashly adopted a few years ago for official international use—and of course fully describes the more satisfactory types of instrument for which he himself is responsible; but does not refer to the Marvin pyrheliometer, now in use by the Weather Bureau—possibly because Prof. Marvin himself has not yet published an account of this as yet unperfected instrument. Since Mr. Abbot's book was written Prof. Humphreys, also of the Weather Bureau, has announced that he is at work at still another instrument of this class.

The chapter on "The Sun's Influence on Plant Life" discusses an important subject which was not touched upon in Young's book, and concerning which there is a dearth of popular literature. From the interesting account of solar engines, solar heaters, and kindred devices we learn that "excepting the solar heaters for bath purposes commonly installed in the roofs of houses, it does not appear that appliances for utilizing solar heat are yet introduced with economical success." Nevertheless, the author is quite hopeful on this subject.

The book abounds in minor typographical errors. Good proofreaders appear to be scarce nowadays in American printing offices. We fear the author himself must be held responsible for misspelling Leverrier's name four times on one page.

REINFORCED CONCRETE CONSTRUCTION. In Theory and Practice. An Elementary Manual for Students and Others. By Henry Adams and Ernest R. Matthews. New York: Longmans & Co., 1911. 8vo.; 316 pp.; illustrated. Price, \$3.

A short history of reinforced concrete paves the way for an intelligent study of theory and practice. The theory is confined to such principles as have a direct bearing upon actual conditions and requirements, and the mathematics of the work are kept within the strictest possible bounds of simplicity. Among the special constructions discussed may be mentioned retaining walls, bins and bunkers, chimneys, reservoirs and tanks, culverts and conduits, swimming baths, public shelters, underground lavatories, railway bridge work, wharves, jetties, and sea walls, and factories. Both American and English examples are usually cited and the numerous cuts are classified and grouped under the various branches of construction, so that each branch graphically presents a variety of typical forms. The work is on the whole admirably adapted to aid the beginner to a knowledge of real conditions, requirements and methods.

CONCRETE COSTS. Tables and Recommendations for Estimating the Time and Cost of Labor Operations in Concrete Construction and for Introducing Economical Methods of Management. By Frederick W. Taylor, M.E., Sc.D., and Sanford E. Thompson, S.B. New York: John Wiley & Sons, 1912. 8vo.; 709 pp.; illustrated. Price, \$5.

In estimating costs, the method advised is that of dividing each kind of work into a series of elementary operations, of timing and recording each of the "unit times," and finally of adding together the results in order to obtain the cost of the job. Tables are given showing just how long a workman should take to do a particular task—tables which have been obtained only after most exhaustive tests with the stop-watch on actual work. Each piece of work in a trade has been reduced to its minor details; the efficient movements of the workman have been isolated from the inefficient and unnecessary; and each elementary movement has been studied with the stop-watch in hand. The series of movements have then been grouped, the unit times summed up, and a sufficient margin allowed for unavoidable delay and accident. Finally, the classification and tabulation of the data has been so carried out as to make practical reference to them a simple and sure matter. The architect, engineer, contractor, superintendent and foreman will all appreciate the help here extended.

THE BRITISH JOURNAL PHOTOGRAPHIC ALMANAC AND PHOTOGRAPHER'S DAILY COMPANION. 1912. New York: George Murphy, Inc. 8vo.; 1,436 pp.; illustrated. Price, paper, 50 cents; cloth, \$1.

This guide, philosopher, and friend of the photographer comes to us this year as multicolored and as copious as ever. The enormous sections devoted to advertisements are bewilderingly kaleidoscopic. They contain some good pictures whose merits are credited to various lenses. The almanac proper calls particular attention to the dates connected with the history of photography—the births and deaths of its great men, its discoveries, inventions, and processes. The reference section has too much matter for a satisfactory summary here, but includes among other things of interest to American readers an epitome of progress for the past year, hints on the management of studios, recent novelties in apparatus, the developing formulas of the principal plate and paper manufacturers, and some useful tables.

PENROSE'S PICTORIAL ANNUAL. The Process Year Book. Edited by William Gamble. Vol. 17, 1911-1912. New York: Tennant & Ward. 4to.; 305 pp. Price, \$2.50.

Those who have seen former volumes will take up this current issue with a pleasurable thrill of anticipation, and there is little chance of their feeling any disappointment. What very little indifferent work is exhibited is so buried in a mass of highly meritorious reproductions that it would be hypocritical in us to resurrect it. A reproduction of the Mona Lisa forms the frontispiece of the volume, and thenceforward mellow colorgravures, rich autochromes, restful monotypes, and bright kinemacolors elbow one another for space between the covers. The wealth of pictures should not lead us to neglect the text, however. There are many papers full of suggestion, information and help. "Photography and Aeroplanes," "On Making Line Drawings from Photographs," "A New Style of Retouching in Machinery Illustrations," "Thoughts of an American Printer," "My Impressions of Kinemacolor"—these few subject-headings will show the diversity and scope of the discussions. No one who professes to keep in touch with illustration and process work can afford to ignore this yearly review, and it is worthy of a place on the table of the general reader and picture-lover merely by virtue of its splendid reproductions and its pleasure-bestowing power.

THE LOCOMOTIVE. Vol. XXVIII. Hartford, Conn.: The Hartford Steam Boiler Inspection and Insurance Company, 1910-1911. Price, \$1.

This bound volume of the little paper called *The Locomotive* contains all the issues of 1910 and 1911, and gives, among other things, a list of boiler explosions for each month, summaries of inspectors' reports, and articles and illustrations dealing with noteworthy explosions and the lessons they convey. An index is included which gives easy access to the miscellaneous information of the volume.

THE MECHANICS OF THE AEROPLANE. A Study of the Principles of Flight. By Captain Duchêne. Translated from the French by John H. Leideboer, B.A., and T. O'B. Hubbard. New York: Longmans & Co. 8vo.; 231 pp. Price, \$2.25 net.

The name Duchêne will be familiar to those who have followed recent progress in aeronautics as that of an original and careful investigator of the laws and principles of dynamic flight. While making no claim to having attained to more than approximate formulae, Capt. Duchêne has made accessible to the general reader and to the student a large body of knowledge concerning the behavior of aeroplanes under varying conditions. The mathematics used are purposely elementary, and all explanations and expositions assume only superficial knowledge on the part of the reader. The clearest possible wording is aimed at, and very generally attained. The four main divisions of the work deal with flight in still air, with the equilibrium and stability of the aeroplane in still air, with the effect of wind on the aeroplane, and with the problems of propulsion. Among other

useful tables are those for rapidly calculating the power required to fly an aeroplane, and for quickly finding the gliding slope. There is a summary of the chief properties of horizontal flight which will be most helpful to the student; and the chapter on the screw propeller is not the least important of the work. As a textbook, it will give the student a fair grounding in principle, and may save experimenters from many discouraging mistakes due to a failure to recognize or to properly take into consideration some necessary factor of a problem.

THE KINGDOM OF DUST. By J. Gordon Ogden, Ph.D. Chicago: Popular Mechanics Company, 1912. 16mo.; 116 pp.; illustrated. Price, 50 cents.

One of the most fascinating things to children the world over is that of observing the Kingdom of Dust as revealed by the sunbeam. In a somewhat speculative but none the less charming manner the author gives us the individual character of the inhabitants of this kingdom—the particles of musk, bits of iron and steel, scraps of leather, fragments of wood, cotton, silk, stone, gold, tin, wool, hair, paper, clay—in short, particles of every ingredient earth knows. His revelations will prove most absorbing to the young, and, aside from conveying instruction of real worth, must kindle in them a desire to pursue such studies further.

THE BASIC OPEN-HEARTH STEEL PROCESS. By Carl Dichman. Translated and edited by Alleyne Reynolds. New York: D. Van Nostrand Company, 1911. 8vo.; 334 pp.; illustrated. Price, \$3.50 net.

The manufacture of steel by the basic process presents many problems which have thus far failed to bring forth adequate solutions. The painstaking investigation of these problems by Carl Dichman is the basis of the volume in hand. He has first endeavored to establish conditions admitting of the complete utilization of raw materials in the best way. This has entailed a vast amount of labor in quantitatively estimating the effect of all determining factors. A lack of knowledge as to the conditions necessary to the economical utilization of fuel led him to devote his initial energies to the theory of gas producer working. The translator recognized in Mr. Dichman's research a most valuable contribution to the science of its subject. The calculations are presented in minute detail, in order that independent investigators may check from step to step as they lead on and up to the eventual formulae. It is hoped that other investigators will use the data in this way, so that the fact or falsity of the author's premises and conclusions may be definitely determined, and the open questions which now vex the subject may receive something approximating to final and unanimous answers.

HOW TO USE THE MICROSCOPE. A Guide for the Novice. By the Rev. Charles A. Hall. New York: The Macmillan Company, 1912. 12mo.; 88 pp.; illustrated. Price, 75 cents net.

The author has written several charming little books designed to conduct the tyro into the fields of Nature by the pleasantest possible paths, and in "How to Use the Microscope" he places the beginner under another debt of gratitude. No attempt is made to describe other than inexpensive instruments and the preparation and elementary observation of common objects. But within its particular scope the primer thoroughly fulfills its mission, and both matter and illustration are commendably attractive and informing.

KEY TO TREES. By J. Franklin Collins and Howard W. Preston. New York: Henry Holt & Co., 1912. 16mo.; 184 pp.; illustrated.

This is an admirable little guide that will be hailed joyously by the tree lovers of the north-eastern United States and adjacent Canada. It is substantially bound, small enough to slip easily into the average pocket, and carries a wealth of illustration upon a very good quality of paper. The identifications are for the most part based upon leaf characters, but a good cut of the bark is generally added. Few technical terms are used, and these are defined in a glossary. The common names are given in full-faced type, the scientific names in italics. There is also a systematic list of trees grouped in families, and a general index to tree names. The size of leaves is clearly indicated by an inch scale, placed beside each outline drawing, and six inches, divided into eighths, are marked off in gilt on the back cover of the book, so that comparisons may readily and conveniently be made.

THE EXPERT WOOD FINISHER. A Complete Manual of the Art and Practice of Finishing Woods by Staining, Filling, Varnishing, Waxing, etc. By J. Ashmun Kelly. Malvern, Penn.: The Master Painter Publishing Company, 1912. 8vo.; 339 pp. Price, \$3.

Maintaining that much of the charm of modern architecture lies in the use of natural woods, the writer endeavors to show how their rich variety of grain and coloring may be developed and preserved. The woods and the fillers used are described at length, and directions are given for ordinary finishing, for finishing and fuming oak, for veneer work, and for French polishing. Stains and staining constitute an important division of the manual, and a wealth of practical formulae is presented. Varnishes, their make-up, tests, and uses, is another capably-handled branch of the subject. Instruction for renovating old furniture and on the treatment of stains and spots brings to a conclusion a very useful exposition of an important art.



READER'S SERVICE

HARDLY a week passes but the Editor receives letters from readers of the Scientific American who ask him whether they shall send their boys to a technical school. Whether a boy shall become an engineer, a chemist or a naval architect are questions that puzzle parents. The Editor will be pleased to aid readers of the Scientific American in deciding the matter of technical education for their sons.

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Scientific American Supplement 1534—"Little-known Properties of the Gyroscope" describes a peculiar action not generally observed, and diminishes the effect of this property upon the motions of the planets.

Scientific American Supplement 1621—The Gyrostat for Ships describes the construction and application of the principle to prevent rolling of vessels.

Scientific American Supplement 1643—The Gyroscope for Balancing Aeroplanes, taken up this interesting field, which the gyroscope alone seems capable of occupying.

Scientific American Supplement 1645—The Theory of the Gyroscope, is an excellent article, treating the subject mathematically rather than popularly.

Scientific American Supplement 1649—The Gyroscope, is an article giving a full discussion of the instrument without mathematics, and language within the comprehension of all interested.

Scientific American Supplement 1694—Gyroscopic Apparatus for Preventing Ships from Rolling, takes up the Schlick invention described first in No. 1621, and discusses in action and results fully.

Scientific American Supplement 1716—A Recent Development in Gyroscopic Design, illustrates a new form of gyroscope and mounting adapted to engineering uses.

Scientific American Supplement 1741—Gyroscopic Balancing of Aeroplanes, tells of various suggested methods of maintaining equilibrium.

Scientific American Supplement 1773—The Wonderful Gyroscope, gives diagrams of the gyroscope and its action, and applications to maintaining stability of ships and monorail trains.

Scientific American Supplement 1814—The Rigid Aeroplanes, describes the latest design of aeroplane stabilizer, from which great things are expected.

Each number of the Supplement costs 10 cents. A set of papers containing all the articles here mentioned will be mailed for \$1.18. Send for a copy of the 1910 Supplement Catalogue, free to any address. Order from your newsdealer, or the publishers

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VII.—Shall My Boy Become a Naval Architect?

By John Ritchie, Jr.

[This is the seventh of a series of articles intended to set forth fairly the business possibilities of the technical professions. The articles are prepared by men who are connected with the more important technological institutions of this country and who are for the most part prominent educators. Because these teachers have instructed hundreds of young men in the principles of engineering, they are best qualified to write upon a subject so immensely important in the future development of American manufacturing industries.—EDITOR.]

THIS was the question asked the other day of Prof. C. H. Peabody, head of the Department of Naval Architecture and Marine Engineering at the Massachusetts Institute of Technology. To him there have come young men, grown men, naval officers, from the nations of Japan and China that are developing their navies for the first time, and have sought the best instruction, the former being represented by an officer who was on the staff of Togo in the war with Russia, while no later than the school year that has just closed an ensign in the Chinese navy was one of his students with others of his countrymen. Then again the United States, recognizing the standing of the department that Prof. Peabody is maintaining, has made it a law that the graduates of Annapolis who are to become naval constructors must come to the Massachusetts Tech for two or three years for the finishing touches.

First, it seems worth while to note briefly what is meant by naval architecture and naval engineering. This is due to some of the changes continually effected in this busy world. When ships were of wood and the towering poops and fore-castles of the three-deckers were susceptible of architectural treatment, the relation to architecture was self-evident. Now that ships are built of steel and crammed with machinery the relation to engineering is unmistakable. But at all times from its artistic side the designing of ships and especially of yachts, has never failed to appeal to those who consider the ship as something more than a mere conveying or fighting machine.

The adaptation of engines to ships, the increase in the functions that machinery are expected to fulfill, the growth in size and complication, and the more precise fitting of the vessel to its work have called more and more for a stronger grasp of principles by the architect as well as greater specialization by the engineer. And the story does not end here for the yards may be adapted each to its own work, some for warships, others for peaceful passenger greyhounds and others still for capacious freighters, while towboats, torpedo craft, yachts and motor boats are calling to-day for extended further specialization.

It may thus be seen that the field is wider than appeared at first, that there are opportunities in large number for the employment of technically trained men.

"The first reason why a young man should become a naval architect," said Prof. Peabody, "is because he wants to, but he must be intelligent, competent and willing to work." The suggestion of this successful professor followed the lines that the designer of ships and yachts, especially the latter, must have a combination of artistic sense and constructive ability, which will find its natural outlet in ship building. Such a person should be allowed to follow his natural bent. There are always a reasonable number of young men in the community who could be successful naval architects if not discouraged by parental caution.

"A second reason," continued Prof. Peabody, "is because there is a much wider field to which the graduates of such a department should go than the public realizes. Anyone who expects to have to do with the designing, building or managing of ships or building marine engines or motors for boats, will be better fitted if he takes a course in naval architecture and marine engineering." The fact is that this profession broadens the knowledge of the man who enters it. It is doubtful whether any other one calls for

an intimate knowledge of so many different industries, for practically all the trades are represented in the modern ship. The design demands a knowledge of abstruse mathematics combined with data obtained from experimental work, and not the least important factor, particularly in the use of what are called "indeterminates," is that rare quality, good judgment, and this is developed by the study. Then the naval architect must be conversant with shop work in all its branches and with steel manufacture, foundry practice, steam engineering and electricity. It is indeed a broad education that is the foundation stone to success in naval architecture.

"Such a course combines the advantages of broad study in engineering," this leader in naval educational work went on to say, "including civil and mechanical engineering with the concentration on a special profession, and in particular the study demands all the advantages in the way of equipment that a large and powerful technical institute alone can furnish."

Then there is the advantage of close personal contact with the teacher in comparatively small groups of students. It must not be forgotten that although the ships of the sea represent the outlay of great capital, they can be counted as but small when compared with the enormous engineering enterprises of the land. It is, therefore, true that while the great demand for land engineers is scarcely supplied by the output in graduates of the great schools, relatively small departments and in comparatively few schools will suffice to supply the need for naval architects. There is room in the naval world for all who are now taking the course, there will be room in the future for an increased output, but there must always be the smaller groups of naval students and the consequent closer touch with the teachers.

Experience has shown that the work of the course really appeals powerfully to all young men who have any taste for the sea or for ships, and they evince an active interest in the work. "They learn to strive hard without feeling the tedium of unengaging work. This of itself is a most valuable education, and many young men who have intended to go into business have taken the course because they liked it."

There must, of course, be considered the business opportunity for members of the profession. This, according to Prof. Peabody, is good. There has for several years been a larger demand for graduates than the school could supply, and this year there were two or three opportunities for each man who graduated.

Most important in the whole consideration is the fact that a brighter day for ship building has already arrived, and the future cannot fail to show an increase of opportunity. The men manning British shipping are now evincing great dissatisfaction with the miserable conditions of the present day and are likely to demand higher pay and other changes which will tend to lift the life to a level where it is possible for it to attract Americans, especially those who like that kind of life, and there are besides special futures for yachting and motor boating which already begin to cut important figures.

Provided he is intelligent, competent and diligent, for the young man who is willing to devote himself to his studies there are at this moment excellent opportunities in naval architecture and marine engineering, and these opportunities are sure to increase in the future.

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Inquiry No. 9280. Wanted names and addresses of manufacturers of machinery for stuffing dolls and teddy bears.

Inquiry No. 9281. Wanted to buy machinery for bleaching walnuts and ivory nuts.

Inquiry No. 9282. Wanted name and address of manufacturer of coin-controlled gasoline-dispensing tanks for automobile use.

Inquiry No. 9283. Wanted name and address of dealers in powdered Cocoa and Kola nuts in bulk.

Inquiry No. 9284. Wanted a plan for washing, screening and loading gravel for concrete purposes.

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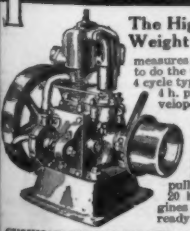
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Uses of Cement in Sculpture

(Concluded from page 192.)

and the steel reinforcing tower, 8 feet in diameter, was built in its place. This tower ran the entire length and ended in a dome just below the neck, and was designed to support the head and shoulders of solid cement. Thirty-eight 1-inch twisted steel rods were cemented 2 feet into the solid rock with molten brimstone and red hot sand. This was done, not to anchor the statue, but to steady the steel reinforcing cylinder. Twenty-four rods were used in the circular tower; 14 anchor rods passed up through the folds of the drapery, joined the structure of the dome and then passed up into the head. This had to serve as a scaffold from now on and retain its form.

For the circular reinforcing 1/2-inch twisted steel rods and 1/4-inch galvanized wire was used. The diameter of the tower was expanded, one wire placed on the inside and one on the outside, and twisted between the rods until tight, thus reducing it to its original diameter.

The solid concrete base (measuring 18 by 18 by 3 2/3 feet) was cast on November 10th. Maintaining a water supply was one of the chief problems of the work. The water had to be pumped up from the river below to a 5,000-gallon capacity storage tank, made in the ground near the statue, then lifted into another tank with an improvised water jet; here it was steam heated for mixing the cement.

An opening was left in the base below the ground, and six sections of the specially designed, collapsible metal inner forms, 7 feet in diameter, were taken in and set one on top of the other and joined together with taper dowel pins. Then on November 14th and 15th the pedestal was cast to within 6 inches of the figure.

Preparations were then made for casting the figure. An improvised derrick with grooved wheels was set over the mold with the hoisting tub working on the inside of the figure. The forms were taken off the pedestal and a chute put in to convey the cement from the mixer to the bottom of the shaft into the hoisting tub, and a small radiator was used to heat the inside of the mold. The first attempt was made to cast the figure on November 29th, but this was unsuccessful owing to inadequate preparations for zero weather.

It has frequently been asked why the final and most important work was not done sooner and in more favorable weather, or left until the following spring. It must be remembered that the whole operation of building a heroic statue in cement was an experiment, and could progress only as each new difficulty, which arose in connection with it, could be overcome. Delay in the material first used was perhaps the main reason for retarding work. Taking into consideration the action of freezing weather on water-soaked plaster, the prominence of the location of the statue, and the terrific wind storms which would sweep around it during the rest of the winter, it was imperative that the building be completed, to avoid a repetition of the first year's work.

Another 16 horse-power steam engine, four large tubular radiators, and one 26-foot steam coil were procured. A 30-foot gravel bin, 5 feet high, was made and the steam coil placed inside it, on edge. The four radiators were placed inside the scaffolding near the mold. The engine being considerably lower, everything was steam connected, and the pipes boxed, with return to the boiler. A system was also devised for warming the water which was being pumped up from the river. The whole construction was inclosed by canvas and sheet tin, all holes plastered shut, and after a final tryout the work began again on Tuesday, December 20th, 1910, at 5 P. M. The thermometer indicated 2 degrees below zero. Two crews of fourteen men each were employed for day and night shifts.

After all the preparation and trials it was a sight never to be forgotten—the two steam engines belching forth thick smoke and flame; the frozen chunks of gravel and solid bags of granite screenings

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Aviation

Two topics are of paramount importance just now in aviation. The one is the possibilities of the hydro-aeroplane—the flying boat in popular parlance—and the other is the flying machine as a military weapon.

In the forthcoming mid-month September issue of the Scientific American, which will issue on September 14, these two subjects will be authoritatively discussed.

Mr. Carl Dienstbach writes on the hydro-aeroplane. He points out how important is the development of the flying boat, because at last we have a vehicle of the air which is safe and which means much for the advancement of flying as a sport.

Major Bannerman Phillips of the British Army, a noted European authority on the military aspects of aviation, will write on bomb-dropping. He will show how much or how little is to be expected by dropping high explosives on an enemy's force from a height of half a mile, basing his comments on the achievements of aerial grenadiers in the Tripolitan campaign and on the results of the bomb-dropping contest held in France.

Dr. Alfred Zahm, America's leading authority on aero-mechanics, will show in a popularly worded article what has been the development of laboratory work since the day of Langley. If the flying machine is to become a really practical vehicle of the air it must be developed by the same methods that have given us giant bridges, huge dynamos, highly ramified telephone systems. That is why Dr. Zahm's article, dealing as it does with investigations made by engineers and physicists, is of immense practical value.

There will also be the usual Scientific American features—the short pithy articles on current scientific events, with many bright illustrations of the latest inventions and scientific apparatus, the latest news for inventors.

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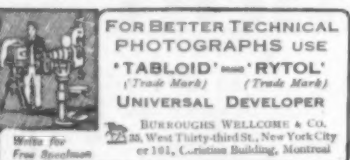
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being thrown into the bin and shovelled out piping hot below; the water boiling, a full steady stream being pumped from the river; the hoisting signals; a typical western blizzard blowing; and above all, the men, contented and happy, working away with clocklike regularity, each at his assigned task.

The granite screenings were kept separate from the other concrete by inserting a row of tins 2 1/2 inches from the mold; these were raised as the work progressed. When a form was full the lowest section was collapsed, hoisted and set on the top section until nineteen sections had been hoisted.

A large hole was cut in the back of the shoulders. The metal form (7 feet in diameter) for the dome was hoisted on the outside and slipped into place, the bucket was changed for outside hoisting, reinforcing rods for the dome were wired into place and a form was built between the dome and the window on the arms.

The work now progressed very slowly, so as to give the cement on the dome a chance to set and help support the thirty tons of solid concrete being placed above it. The only breakdown occurred at 3 A. M. on the last day of the work. With the temperature below zero, both engines suffered a temporary breakdown for half

an hour, and all but froze the cement which was then on a level with the eyes. At this stage the cement was passed up in pails. On December 30th, 1910, at 2:45 P. M., the huge mold was full. Heat was applied for two more days and then the Spirit of Black Hawk, as the statue is often called, was left to the elements until the following spring.

I think the most exciting time in making a statue—and I am sure all sculptors and bronze founders will agree with me—is the moment when the mold is about to be chopped off. Will it come out perfect or not? Needless to say this part of the work had to be investigated as soon as the weather permitted.

In the early spring a party of three, Mr. Lorado Taft, Mr. Wallace Heckman, attorney for the University of Chicago, and upon whose land the statue stands, and I, investigated the result of our labor. I took photographs from a scaffolding as the piece-mold was taken off the head and shoulders. So far the result was entirely satisfactory.

Two weeks later the rest of the mold was taken off by splitting it from top to bottom and prying it off in huge slabs. At last there emerged a perfect—except for a few minor defects—monolith cement statue.

Practising Efficiency and Knowing Costs Abstract of a Letter to a New England Manufacturer By Harrington Emerson, Efficiency Engineer

DEAR SIR: In compliance with your request of last week, I give you here-with the substance of my remarks on practising efficiency and knowing costs.

In the operation of any undertaking one may attain high efficiencies and know little about costs, or one may know all about costs and practice no efficiencies. Which is more important?

When I was manager of a glass works I occasionally took Sunday dinner with a French glass-blower. Such meals for flavor and savorness I have never eaten anywhere before or since, not even in the best restaurants of Paris, London and New York. The wife who cooked and served the meals was a French peasant woman, unable either to read or write. Her husband gave her \$20 a month to run the table. She could scarcely count, so she would buy one thing at a time and pay for it, receive the package and change and then buy another item. She also had a garden full of marvelous vegetables and herbs. My! but she was efficient as to quality; she did not pay more than she ought in price nor did she buy table salt mixed with corn starch at \$0.10 a pound when rock salt at \$0.02 answered the purpose as well. My! but she was efficient as to quantity; she did not buy more than she needed nor did she ever use more than enough. This peasant woman did not know anything about cost-keeping, but she was a born and trained manager, practising that French thrift which has made the French nation one of the richest in the world.

I also knew a young American who had "system" on the brain. He subdivided his expenses under a great number of heads. He did not have a very large income—had to earn or beg or borrow it. He would pay any price that sellers asked, and he bought fourteen-dollar shoes when three-dollar shoes would have answered. He had twice as many suits as he needed, and he got very little use out of them. It was the same with food, with lodging, and with travel. On trains he paid extra fares, took the drawing-room, but spent most of his time in the buffet car. My! but he was inefficient; paying more than he should for everything, using higher qualities, buying more, using more than he should. Yet his accounts were beautifully drawn up in blue and red and green inks as well as black.

Which quality is more important in running a plant, efficiency or system?—the efficiency of the Scotch, the Quakers, the Yankees and the Swiss, or the system that balances up United States ex-

penditures to a cent and spends in proportion to what it gets four times as much money as the Swiss Republic?

No doubt there are efficient French managers who know how to read and write and figure. No doubt there are systematic men who also practise efficiency, but the point I wish to make is that efficiency and system are totally different and that efficiency is by far the more important of the two. If I knew that every part of a plant I was managing was being operated at 100 per cent efficiency, detailed costs would be relatively unimportant. To know every cost, yet not know what the efficiency is, whether high or only 50 per cent, is as reckless as to run a steam boiler without safety valve or steam gage, trusting that it will not blow up.

Efficiency is the relation between what is and what ought to be. To determine what actual costs are is a clerical task, but this helps very little if we do not know what costs ought to be. Also, even if we are told what costs ought to be, it requires all sorts of skill to attain the ideal.

We may be running a foundry in which our castings cost \$2.75 per hundred pounds. We may know that in another foundry similar castings cost \$1.75 per hundred pounds. In such cases it is very usual for the superintendent to blame the equipment, to assert that if he had a new foundry with new equipment he could undoubtedly surpass the rival. It is also quite usual for the owners to blame the superintendent or the equipment and to advocate a change. Nobody knowing where or why the losses occur, everybody blames somebody or something else. If the where and the why are known, a thousand-dollar investment might cut the cost to \$1.75. If the facts and remedies are not known, the emotional expenditure of \$100,000 might run the cost up to \$3 per hundred pounds. There is, therefore, a great difference between the relative importance of cost determinations (only a fraction of the efficiency principle of "Reliable, Immediate, Adequate and Permanent Records") and the skilled experience that can determine fair standards, and there is also a great difference between the analytical ability to determine fair standards and the executive ability and skill to attain them.

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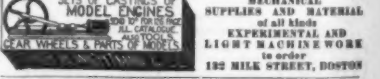
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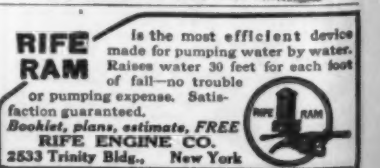
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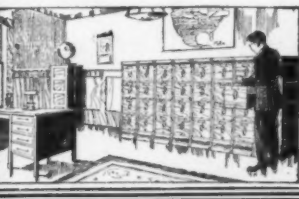
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hour glass, a water clock, or by the beats of a pendulum regulated to an hour glass. It does not seem that even these elementary records, corresponding to cost accounting, were applied until about one hundred years ago. After thirty years of records as to trotting horses, one or two men who had given the subject life-long practical study set the extreme achievement of the trotting horse at two minutes. It took forty years more of intense refinement of track in shape and surface and banking, intense refinement of shoes and harness, intense refinement and improvement of sulky, intense and special skill on the part of driver as well as immense betterment in the physical welfare and training of the horse to realize two minutes out of the most carefully and selected bred horse.

Efficiency work is not overhead expense. It is a productive department whose motto is "Wealth from Waste." An efficiency department is inexcusable unless it yields in gain even the first year several times what it costs. If there is a big loss due to inefficiency, it may cost anywhere from \$5 to \$50 to rescue \$100. If the plant is a small one the percentage of cost to saving is naturally higher than if the plant is a large one, though an efficiency scheme in its elements is essentially the same for the little plant as for the big one. Even if in a little plant an expenditure of \$50 yields only \$50 net profit, it is after all a remarkably productive investment.

The largest part of the value of the efficiency counselor is that he knows what not to do. If a chicken is put in a cage or maze from which it can escape only by taking one course out of a hundred, it will take it half a day of anxiety, of fluttering, before it accidentally strikes the right combination and gets out. If put back again it takes a shorter time to get out, and finally by not taking the wrong paths it makes its way out in a few minutes. Its improved efficiency is due to the omission of mistakes.

Any one can open a tumbler lock if he knows the combination. If he does not know it, the chances against hitting it, by accident are many, and this alone constitutes the safety of the lock.

So, too, in efficiency work, there are a score of things that must not be done for every one that must. It requires thorough knowledge of efficiency principles and long experience in their application to know what "not to do," and in knowing these pitfalls lies success in applying efficiency principles.

Very truly yours,
HARRINGTON EMBERTON.

How Much Bread Will a Given Quantity of Flour Make?

FEW people, other than the bakers, have even the most remote idea of how much bread a barrel or any other quantity of flour should yield or how much more one brand will make than another. This is a much more important matter than the mere question of whiteness of the bread, or even of its real or apparent lightness. For some brands and lots of flour are much drier than other kinds, and will absorb much more water to bring them to the same degree of dryness as other brands, or other lots of the same brand. Further—and what is of much more importance—the quality of gluten contained in the flour, which is the more nourishing of the two principal constituents, determines much more largely than does the starch, the amount of water that the flour will take up. The best should be the cheapest, if the amount of bread made per pound under the same conditions is proportionately greater than the price demanded therefor. I happen to have on hand data concerning two well-known American brands, namely, "Gold Coin" and "Seal of Minnesota." From the former, a good baker or housewife can make about 345 pounds of dough per barrel of 196 pounds of flour, that is, 176 pounds of dough per 100 pounds of flour. Of the second brand, the figures at my disposition show 168 pounds of baked bread per 100 pounds of flour.

GET IN THE SMOOTH SMOKE CIRCLE

Velvet

THE SMOOTHEST TOBACCO

Look out there now—steady—take your time, old man! Make him put it over!
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Velvet—smoothes of all smokes—fine flavor. IT HELPS!

Liggett & Myers Tobacco Co.

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HANDY 5¢ BAGS
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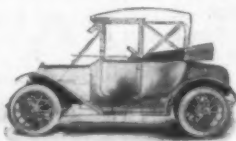
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